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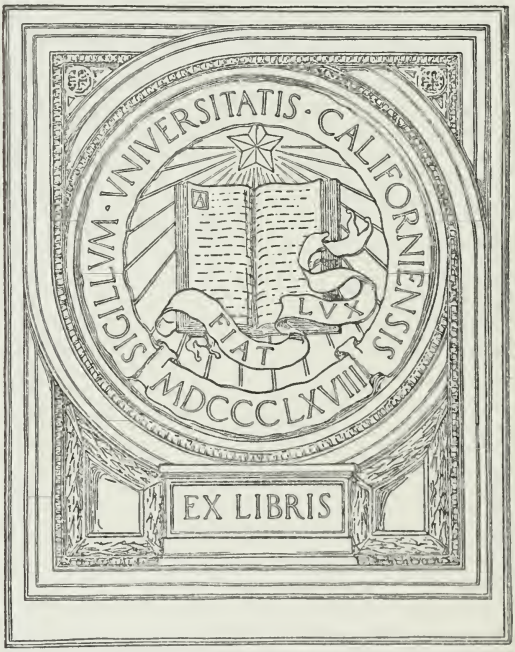

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A MANUAL OF DISEASES OF THE NOSE, THROAT, AND EAR

BY

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Illustrated

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TO

Hon. Henry F. Walton,

PRESIDENT OF THE MEDICO-CHIRURGICAL COLLEGE AND HOSPITAL, PHILADELPHIA

A LEARNED, GENIAL GENTLEMAN
AND
A GOOD FRIEND

IN AFFECTIONATE APPRECIATION OF HIS MANY ACTS
OF KINDNESS AND WORDS OF WISE COUNSEL
THIS LITTLE BOOK IS INSCRIBED

BY

THE AUTHOR

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PREFACE

This manual was written to supply students and general practitioners with the essential facts of Rhinology, Laryngology, and Otology in as concise a form as possible.

The more important facts of the anatomy, physiology, and pathology of the upper respiratory tract and ear have received careful consideration, so that the volume might prove sufficiently complete for study or reference by undergraduates during their college years and for practitioners taking a post-graduate course in laryngology and otology.

The details of inspection, examination, and diagnosis of the nose, throat, and ear conditions and the use of the commoner instruments of diagnosis and for the making of applications have received very careful and comparatively lengthy detailed description. The same may be said of minor operations. Methods of treatment have been simplified as much as possible, so that in most instances only those methods, drugs, and operations have been advised which, by the actual experience of the author, have proved essential to the accomplishment of the desired result. At the end of the book is a collection of Formulas designed to represent more than a mere catalogue of prescriptions. Hence a detailed description of the better methods of use of each of the more important drugs has been interpolated, which it is hoped the reader will find useful and suggestive.

The history of the gradual development of some of the more important instruments, methods of treatment, and, more especially, operations has been considered of sufficient practical importance to be briefly outlined. In some instances the prognosis in cases not operated on has been accentuated by quotations from the writings of standard authors of the period before such operations were practised.

The book contains 262 engravings, a considerable proportion being original or drawn from dissections made by the author. The value of carefully made sections through the upper respiratory tract and ear for purposes of study and reference is stated and a method of preparing and preserving such specimens described.

E. B. GLEASON.

PHILADELPHIA, May, 1907.

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DISEASES OF THE NOSE, THROAT, AND EAR

THE LARYNGOSCOPE

The laryngoscope is a combination of two mirrors arranged to enable the observer to see the interior of the larynx. The larger and concave mirror, called the reflector, is attached to the observer's head by a head-band, and the smaller and plane mirror, called the laryngeal mirror, is introduced into the back part of the mouth in such a manner as to be directly above the glottis; so that light reflected from the reflector upon the laryngeal mirror illuminates the interior of the larynx, and enables the observer to see its image in the small mirror.

In 1854 Signor Manuel Garcia, by means of a dentist's mirror and a hand-glass, *studied* the movements of his own vocal cords during phonation, and accurately described the registers of the voice in a paper read before the Royal Society of London in 1855, and hence the honor of inventing the laryngoscope is usually accorded to Garcia. In 1857 Türck, of Vienna, began to use the laryngeal mirror on his patients, and he and Czermak, who substituted artificial light for sunlight, improved their apparatus until the laryngoscope was perfected to the form that is used at the present day.

The **laryngeal mirror** consists of an oval or round piece of silvered glass, mounted in a metal frame and attached to a wire stem at an angle of not less than 120 degrees. Such mirrors vary in size from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches in diameter, and are numbered 1, 2, 3, 4, 5 by instrument-makers. However, smaller mirrors, Nos. 00 and 0, and larger mirrors,

Nos. 6, 7, and 8, may be obtained, and are occasionally useful. The wire stem is either fixed in a handle or slides into a hollow handle of metal, and is clamped at any desired length by a set-screw (Fig. 1).

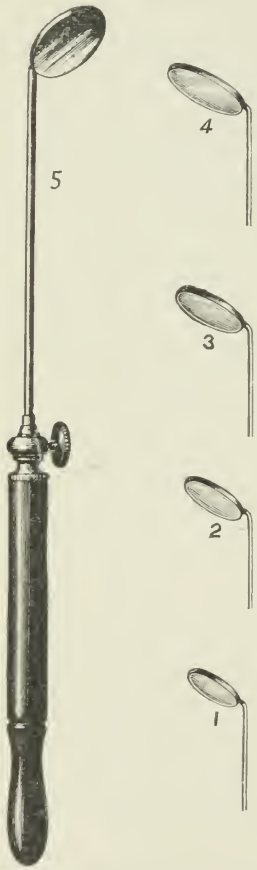


Fig. 1.—Laryngeal mirror in universal handle.

The **reflector** is a concave mirror $3\frac{1}{2}$ inches in diameter, of about 12-inch focus, and made of silvered glass, mounted in a metal frame, so arranged that it is capable of attachment by a universal joint either to a head-band or the source of illumination.

The instrument known as **Fox's head-band** (Fig. 2) consists of four steel or, preferably, brass strips, because steel, though lighter, readily corrodes. The metal strips are hinged together so that they can be folded about the mirror, so as to protect it and form such a small and conveniently shaped package that both head-band and mirror readily can be carried in a pocket of the surgeon's clothing. When in use the head-band assumes the position of a line passing over the head from the forehead to the occiput. It is held firmly in position by the hinged bands, which when unfolded act as a spring. It has the advantage that at once it adjusts itself to heads of varying shapes and sizes, and hence is convenient in class-demonstration to pass from student to student. However, a head-band of leather is decidedly the preferable instrument, because it is lighter. The leather should be black to prevent discoloration by sweat. Head-bands of rubber elastic are soon corroded by sweat from the forehead and are rendered useless. The joint by which

the mirror is attached to the forehead is by no means a matter of indifference, a double ball-and-socket joint greatly facilitates the adjustment of the reflected light, and renders it possible to bring the perforation in the center of the

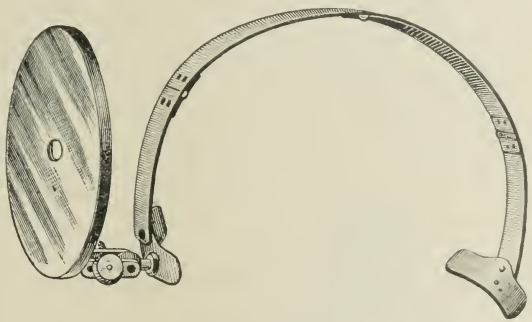


Fig. 2.—Reflector with Fox's head-band.

reflector closer to the eye, a decided advantage in examining narrow cavities like the nasal passages or the auditory meatus. Some years ago the author had made for use in his class-room the head-band shown in Fig. 3. At that time

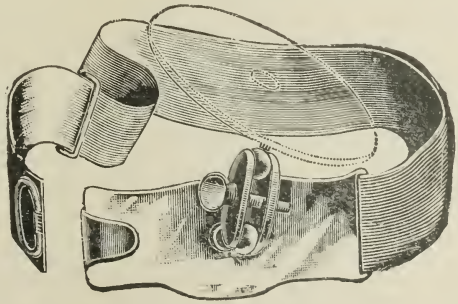


Fig. 3.—Gleason's head-band.

his principal object was cheapness. The instrument, however, proved so light, comfortable, and efficient that it has become his favorite head-band.

Proper Method of Wearing the Reflector.—The reflector should be worn upon the forehead over the left eye, and the

light should be reflected from it upon the face of the patient, so as to form a circle, bounded above by the tip of the nose and below by the front of the chin. When worn over the left eye, with the source of illumination to the left of the patient, it is possible to secure a better illumination of the nose and mouth with less frequent manipulation of the reflector. If, however, the source of illumination be at the patient's right, the reflector is more conveniently worn over the right eye.

The sources of light used in otoscopy are natural and artificial.

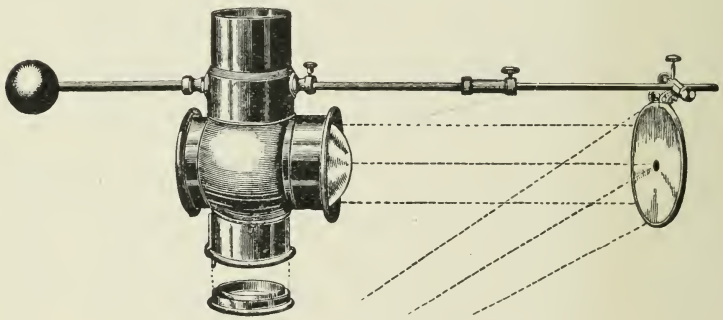


FIG. 4.—Light concentrator, with reflector.

Daylight, preferably that reflected from a white cloud, or artificial light, furnished by an Argand burner fed by oil or gas, or the electric light, is now generally used. Whatever the source of the illumination, the light is directed into the auditory canal, mouth, or nose by means of the reflector.

Tobold, Mackenzie, and others invented light concentrators, where convex lenses are used, to concentrate the light upon the reflector. Such an apparatus, containing one or more lenses and made to fit over a student's lamp or Argand burner, can be obtained in the instrument stores. The apparatus shown in Fig. 4 is perhaps the best of these, and may be used either over an ordinary student's lamp, Argand burner, Welsbach light, or the electric light can be placed within the apparatus. The bull's-eye lens shown in the figure is advantageously replaced by a disk of plain glass, such as is used in bicycle lamps, and the reflector

brought much nearer the lamp. The Welsbach light gives by far the most satisfactory illumination, but because of the frequent moving of the bracket the mantle, which should be used without a glass chimney, has a much shorter life than if the light were stationary. However, in spite of this disadvantage, the Welsbach light is probably the best for office work and the Argand burner for the dispensary or elsewhere when the lamp is liable to rough handling. The electric light, after it has passed through the lens and been reflected by the mirror, yields a bright image of the filament with deep intervening and surrounding shadows. To overcome this difficulty, Veeder had the filament made into the form of a disk.

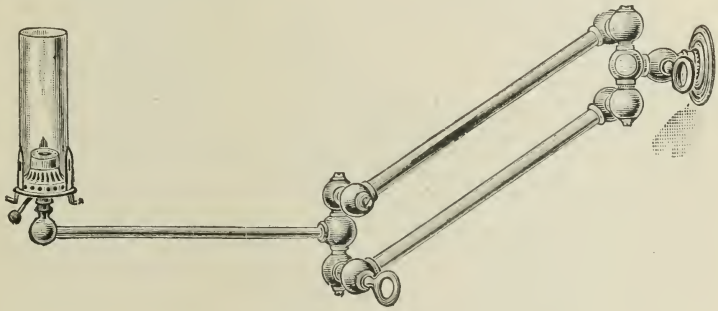


FIG. 5.—Adjustable gas bracket.

As shown in Fig. 4, the reflector is attached to the light concentrator in such a manner that it will reflect light into the nose, mouth, or ear, and thus do away with the necessity of wearing the reflector upon the forehead. This arrangement is a decided advantage, because a forehead reflector if worn all day is apt to result in a headache.

The **source of light** should be at the patient's right (Fig. 7), somewhat behind him, and on a level with the top of his ear. As the heights of patients vary greatly when seated, it is well to have some means by which the position of the light can be quickly and conveniently changed. There are several forms of adjustable gas brackets manufactured that answer fairly well. One that can readily be manipulated with the left hand while the operator remains seated will be found to

be the most convenient. That shown in Fig. 5 has large conic bearings which do not wear loose so rapidly and leak as some of the other patterns.

THE ART OF LARYNGOSCOPY

Laryngology is the art of seeing and describing what is seen in the larynx. The word signifies a treatise on the larynx and its diseases. **Laryngoscopy** is simply the art of viewing the interior of the larynx.

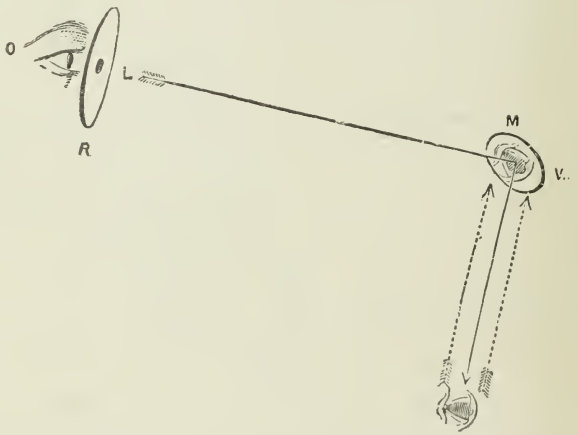


Fig. 6.—Diagram illustrating the principle of the laryngoscope (Lennox Browne).

The optical law involved in laryngoscopy is that *the angle of reflection is equal to the angle of incidence.*

This law is illustrated by the fact that the laryngeal mirror must be placed in the back part of the patient's mouth, above and behind the larynx, and at such an angle that light received on its surface is reflected downward into the larynx. The rays then forming the laryngeal image will return along the same path, and be reflected at the same angle into the eye of the observer. From this it follows that the nearer the center of the head-mirror is placed to the eye of the observer, the better will the image of the larynx be seen (Fig. 6).

We should bear in mind that the laryngeal image is a reflected one, and that, therefore, it is reversed antero-posteriorly, owing to the fact that the laryngeal mirror is above and behind the opening of the larynx (Fig. 8).

The observer should sit opposite to the patient, so that his eye is on a level with, and about a foot from, the mouth of the patient, whose head should be slightly raised and inclined backward. The knees of the observer should be

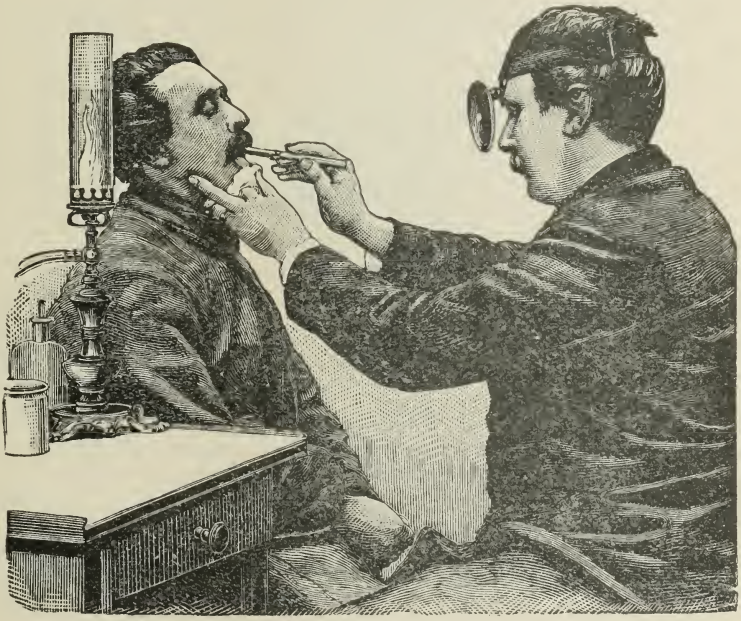


Fig. 7.—Technic of laryngoscopy (Sahli).

either at the left or on either side of the patient's knees. For office use it is most convenient to have piano stools, which can be raised or lowered, so that the difference in the heights of different patients can be compensated for, and the eye of the observer can be brought on a level with that of the patient; while the patient's head may rest upon a cushioned framework fastened to the wall. All ordinary piano stools

are not especially ornamental. Chairs of various designs have been manufactured. Most of these for ordinary office work are less convenient than two piano stools, which can be made of ornamental design and luxurious appearance, while a padded wall affords an efficient head-rest for the patient.

If a head-reflector be used, it is advisable for the observer first to place his head in an easy position, and *then* move the reflector until the disk of reflected light falls in the opened mouth of the patient with its center at the base of the uvula, thus illuminating all the surrounding parts. This method of procedure has the very practical advantage that if the observer has to turn his head to see to pick up an instrument or for any other purpose, bringing his head back into the former easy position at once reilluminates the patient's pharynx without readjusting he reflector.

FIG. 8.—Diagram of laryngeal mirror, illustrating the reversion of the reflected image (Lennox Browne).

Introduction of Laryngeal Mirror.—The laryngeal mirror is first warmed by holding its reflecting surface over a flame for a short time to prevent moisture condensing upon it. The handle should be held between the thumb and forefinger of the right hand like a pen-holder, with the reflecting surface of the mirror downward. The forearm should be flexed upon the arm and the hand slightly backward upon the wrist and held a little below the mouth of the patient. By a forward motion of the hand and a slight raising of the arm and unbending of the elbow the mirror should be quickly carried into the mouth, following the curve of the hard palate until the back of the mirror touches and raises the uvula, pressing it upward and backward as far as possible. Meanwhile the left hand of the observer has grasped the patient's protruding tongue, holding it well forward by means of a towel or napkin to prevent slipping through the fingers.

Controlling the Tongue.—The protruded tongue of the patient should be grasped between the outstretched thumb

and index-finger of the left hand, protected by a napkin or towel to prevent slipping, in such a manner that the fore-finger being placed against the lower teeth, projects above their edge, and thus forms a roller upon which the tongue can move without its frenum coming in contact with the sharp edge of the lower incisors. The thumb being placed

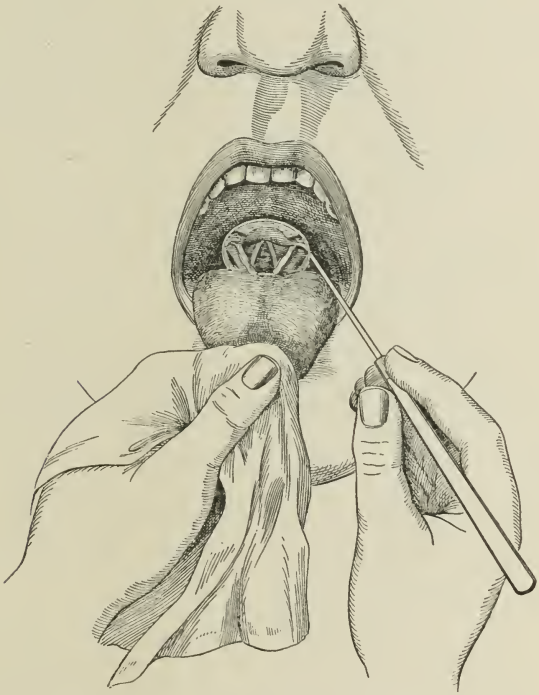


FIG. 9.—Method of making a laryngoscopic examination (Anders).

on the upper surface of the tongue and the middle finger above the chin of the patient, a slight rotatory motion of the observer's left hand will then not only control the motion of the tongue of the patient, but also keep all involuntary movements of his head in check, as the bit in a horse's mouth controls the animal's action. When the operator has to use both hands in operating or making

applications, the patient should be taught this maneuver and requested to hold his tongue forward himself.

The mirror should not touch the tongue or palate; and, when in position, it should be held steadily and not allowed to tremble, or gagging as well as retching will result. Should the slightest sign of this occur, the mirror must be quickly withdrawn, and only reintroduced when the patient has had time to recover his breath and confidence; or the gagging will be repeated on an attempt to reintroduce the mirror, and the throat finally become so sensitive that a further examination will be impossible at that sitting.

To bring the laryngeal image into view the handle of the mirror is brought to one side until it lays in the angle of the patient's mouth, and the hand holding it is steadied by one or two fingers resting on the cheek of the patient. This procedure brings the hand out of the line of vision. The mirror is next slowly but steadily turned until the image of the larynx appears upon its surface. The patient should now be requested to say "Ah," in order to cause a rising of the epiglottis and bring the glottis into view (Fig. 9).

The **temperature of the mirror** should always be tested by laying the back of the mirror against the skin of the hand, and never against the cheek; because a slight abrasion of the skin of the cheek easily escapes notice, and may be inoculated with specific poison by the back of the mirror, which has previously come in contact with the secretions of a patient suffering from specific disease.

Obstacles to laryngoscopy are: 1. *Irritability* of the pharynx, produced by trembling of the hand holding the mirror, causing gagging and retching. 2. Want of proper *adjustment of the light*, without which the larynx cannot be illuminated, even when the mirror is in the proper position. 3. Undue irritability or peculiar formation of certain parts of the throat. 4. Raising of the back of the tongue upon the approach of the mirror, in spite of the traction made upon its tip. 5. Too large or pendent epiglottis.

Gagging and retching can generally be prevented by avoiding to touch the tongue and palate while introducing the mirror, and by holding it steadily in its proper position when introduced. Irritability of the pharynx may be re-

lieved by letting the patient swallow a glass of ice-water before introducing the mirror; or, if that should fail, the use of a spray of cocain solution from an atomizer will generally produce the desired effect. If the back part of the tongue rises so as to obstruct the view, in spite of traction on its tip, it may be caused to lie flat in the mouth by steady pressure with a tongue-depressor (Figs. 10–12). When the epiglottis is too large or pendent, so as to obstruct the view, we can sometimes see the glottis by causing the patient to laugh or sing in a high pitch.

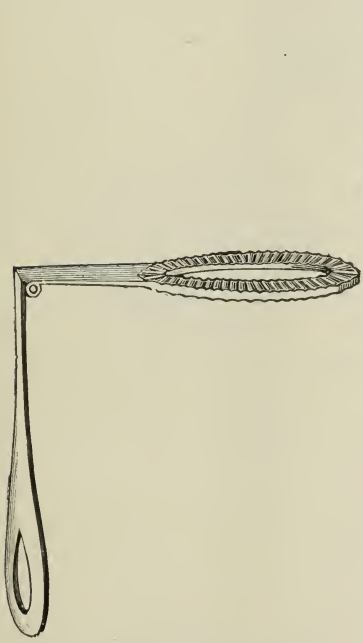


FIG. 10.—Folding tongue-depressor.

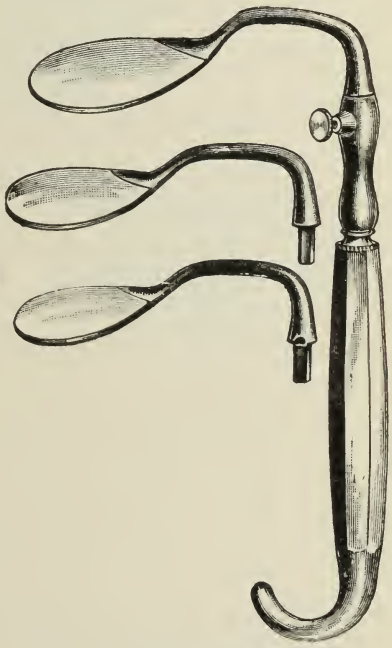


FIG. 11.—Turck's tongue-depressor.

Autolaryngoscopy.—The observer who wishes to study his own larynx should seat himself with his back toward a window through which the direct light of the sun enters. In front of him should be a plane mirror, so placed as to reflect a ray of sunlight into his open mouth. All being in readiness, he seizes his tongue with a napkin held in his left

hand, and pulls it forward. His right hand now carries a laryngeal mirror to the back of the mouth, its progress being watched in the mirror before him. When properly placed, the sunlight from the plane mirror is reflected by the laryngeal mirror into the larynx, and its image appears upon the laryngeal mirror and is reflected forward upon the plane mirror, where it may be studied by the observer. Artificial light may also be used for autolaryngoscopy by

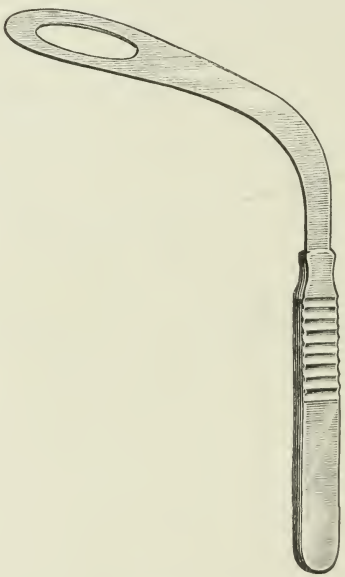


FIG. 12.—Bosworth's tongue-depressor.

having the source of illumination at one side of, on a level with, and slightly behind the observer's head; while a concave reflector is placed at one side of the plane mirror to reflect the light upon the laryngeal mirror in the back part of the mouth.

Infraglottic Laryngoscopy.—In some cases in which tracheotomy has been performed and the cannula is fenestrated, a small mirror may be so introduced into the cannula as to obtain a view of the under surface of the vocal cords,

which are red instead of white. Unfortunately, the mirror must be so small that little else can usually be seen.

LARYNGEAL IMAGE

Normal Image.—At the upper part of the mirror (Figs. 13–15) is seen the reddish-yellow arch of the epiglottis (L) with its cushion (C). In front of the epiglottis and extending downward across the mirror are seen two pairs of bands—

FIG. 13.—The larynx in gentle breathing (Lennox Browne).

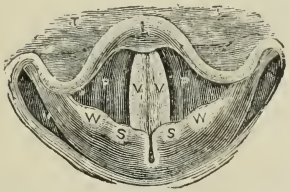


FIG. 14.—The larynx in tone-production (Lennox Browne).

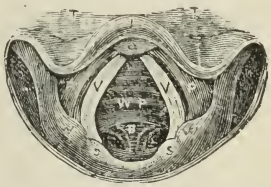


FIG. 15.—The larynx in deep breathing (Lennox Browne).

the outer red, and the inner of a pearly white. The former are the ventricular bands (P), while the latter are the vocal cords (V). In deep breathing, a triangular opening is seen between the vocal cords, through which we can see into the inferior cavity of the larynx and view the anterior part of the cricoid cartilage as well as some of the tracheal rings below it (W, P). In some cases two dark circles can be seen in the depth of the trachea, indicating the openings of the bronchi (B). During tone-production the opening between the vocal cords is narrowed to a slit, and this space is called the *rima glottidis* or *glottis* (chink of the glottis). At the termination of the vocal cords we see the arytenoid cartilages, with the interarytenoid space or commissure between them. From each side of this commissure a fold, called the *aryepiglottic fold*, extends forward to join the arch of the

epiglottis. Upon each of these folds we see two nodules—the cartilages of Wrisberg (w) and these of Santorini (s). These latter surmount the arytenoid cartilages. Attaching the epiglottis to the tongue is seen in the mirror a light-colored band—the glosso-epiglottic fold. On each side are two grooves, called the glosso-epiglottic fossæ. The color of the mucous membrane, as seen in the laryngeal image, varies from the pearly whiteness of the vocal cords to

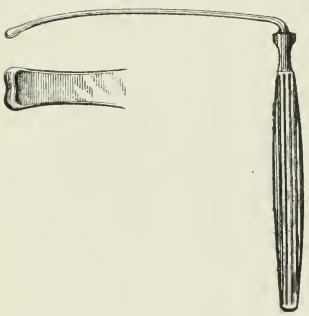


FIG. 16.—Tongue-depressor for pharyngoscopy and direct laryngotracheoscopy. Side-view and surface-view of the anterior portion. In some cases an instrument with a larger curve of the anterior portion is more practicable (Kirstein).

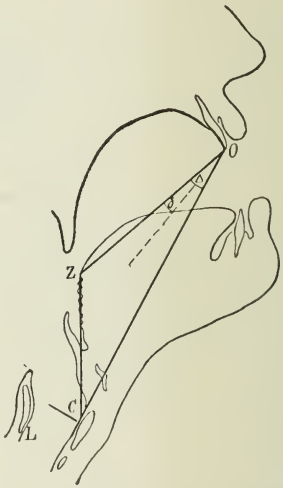


FIG. 17.—Displacement of tongue in autoscopy; *L*, Larynx; *CZ*, normal position of tongue; *CO*, position of tongue in autoscopy (Kirstein).

the reddish yellow of the epiglottis and the pink red seen in other localities. There is also considerable variations of color, within the limits of health, in different individuals, and even in the same individual under different conditions. As seen by artificial light it is always redder in color than when seen by means of direct sunlight.

Autoscopy of the larynx and trachea is a name given by its discoverer, Kirstein of Berlin, to a method of direct inspection of the living larynx and trachea by means of a special tongue-depressor (Fig. 16), by which the tongue can be

drawn forward as well as pushed downward, as shown in Fig. 17.

The patient should bend the upper part of his body slightly forward, as shown in Fig. 18. For purposes of examination it is sometimes desirable that the patient remove his collar, especially if it be tight fitting. False teeth should always be removed. The observer stands in front of the patient, who is seated, and throws light from the reflector into the patient's open mouth. The tongue-depressor is grasped in the left hand in such a manner that its tip catches

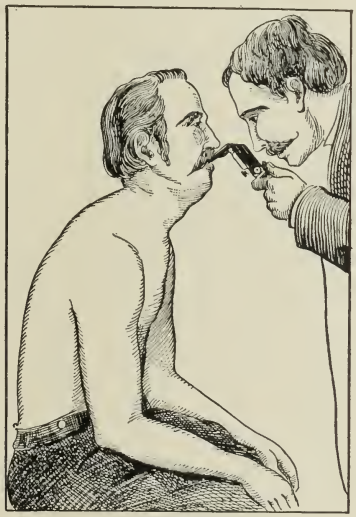


FIG. 18.—Position for autoscopy. This drawing was made from a partly stripped patient in order to show distinctly the position of head and neck during examination (Kirstein).

in the groove between the tongue and epiglottis, being careful not to rest the tongue-depressor on the anterior portions of the tongue. The base of the tongue is now drawn evenly and steadily downward and forward as far as possible without exercising any force. If these maneuvers are successful, the arytenoids are first brought into view and, finally, the whole interior of the larynx and a portion of the posterior wall of the trachea. In this respect the method con-

trasts with the use of a laryngeal mirror, in which, if the trachea is seen at all, it is a portion of its anterior wall.

Even in the hands of an expert, autoscopy, as described by Kirstein, yields satisfactory results in only a comparatively few adults and seldom in children. However, the

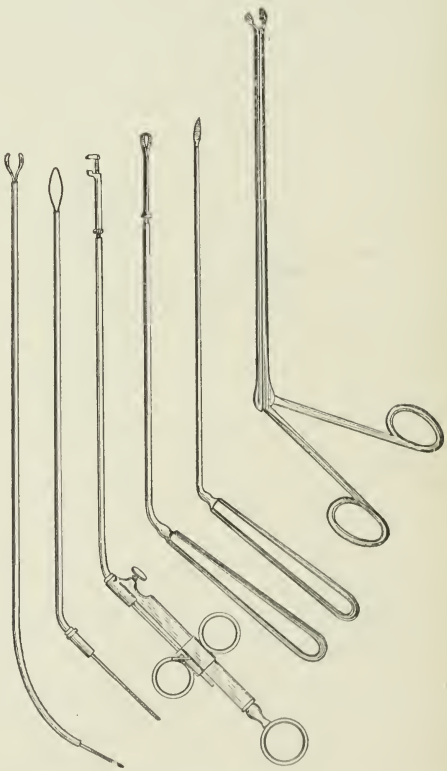


FIG. 19.—Types of instruments for autoscopic operations (Kirstein).

student should practise the method until he becomes expert, and should be careful to exercise sufficient discretion and gentleness to rarely if ever cause pain. Kirstein states: "The autoscope is an instrument in using which the physician can hurt *every* patient, but should hurt none."

Advantages of Autoscopy of Larynx and Trachea.—For purposes of examination autoscopy possesses rarely any advantage over laryngoscopy, although yielding a somewhat better view of the posterior wall of the larynx and trachea; but for those who have already familiarized themselves with the use of the mirror, the method seems more difficult and awkward. For the removal of tumors and foreign bodies from the posterior wall of the larynx or pharynx the method has great advantages, as straight instruments can be used under the direct guidance of the eye; but the anterior wall of the larynx and even the posterior surface of the epiglottis is rarely brought into view as well by autoscopy as by the use of a mirror. Fig. 19 shows the instruments that have been employed in autoscopy for the removal of tumors, foreign bodies, etc., from the larynx.

RHINOSCOPY

Rhinoscopy is the art of inspecting the nasal cavities, and may be divided into anterior and posterior rhinoscopy. Anterior rhinoscopy is the inspection of the anterior nares through the nostrils, and posterior rhinoscopy is the inspection of the vault of the pharynx and of the posterior nares from behind.

The word **nares** should be applied solely to the anterior and posterior openings of the nasal cavities. The posterior openings are sometimes called the *choanæ*.

The **postnasal space** or **nasopharynx** is the cavity bounded in front by the posterior nares or choanæ, above by the vault of the pharynx, behind by the pharyngeal wall, and below by the soft palate. Is is frequently termed the *nasopharynx*.

Technic of Rhinoscopy.—The simplest method of inspection is to raise the tip of the nose with a finger, and draw the ala away from the septum by means of a bent probe. If now the patient's head is tilted somewhat backward, so that a strong light from a window or other source of illumination can enter the dilated nostril, the nasal cavity will be illuminated for a considerable distance, and the condition of its lining mucous membrane may be inspected. This was

the method commonly employed previous to the invention of the forehead reflector. The opening of the nostril may, however, be effected more conveniently by means of an instrument called a *nasal speculum*, of which there are a great variety for sale in the instrument stores. Of these one of the most popular is *Myles' speculum* (Fig. 20). It has the advantage that its solid blades push the hairs of the vestibule to one side so that they do not interfere with the view. It is "self retaining" to a considerable extent, which is a decided advantage. It is not self retaining, however, to anywhere near the same degree as the instrument shown in Fig. 21, which in most noses cannot be displaced by facial contortions of the patient. He has to use his hand in order to remove it from his nose. It is sometimes necessary, however, to snip away the vibrissæ before an operation in order to obtain a better view of the interior of the nose. This occupies but a moment and is a matter of little consequence.

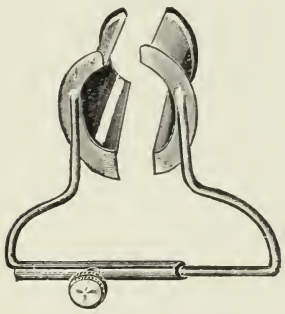


FIG. 20.—Myles' nasal speculum.

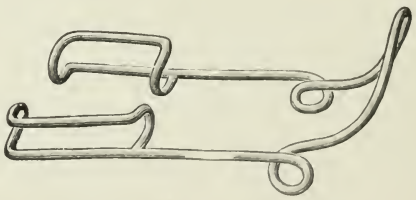


FIG. 21.—Gleason's nasal speculum.

The idea of devising a speculum was given the author by Dr. L. L. Palmer of Toronto, who, while visiting Philadelphia, showed an eye speculum which he had bent in such a manner as to serve an admirable purpose as a nasal speculum. Two sizes of the instrument should be at hand, and the spring of the instrument should be adjusted by bending until it does not cause sufficient pressure to occasion the

patient pain or annoyance. The instrument is introduced by directing its blades along the floor of the nose until they have nearly disappeared within the nasal chamber, when the instrument is turned upward until it assumes the position shown in Fig. 22. It is probably the best "operation speculum." Allen's speculum or that of Myles is better for inspecting the nasal fossæ.

Most nasal specula tend to expose the parts in a distorted condition, and thus deceive the observer as to the amount of breathing space that exists in the anterior nares. Harrison Allen's hard-rubber nasal specula, as they do not

Fig. 22.—Gleason's self-retaining nasal speculum in position.

dilate the nostrils so widely, enable the observer to judge of the amount of obstruction to nasal respiration produced by a deviated septum or anterior hypertrophy much more accurately than he could do with a dilator; and a nest of these instruments should always be at hand to be used in such examinations (Fig. 23). When using a nasal speculum the instrument and patient's head should be moved in such a way that the different parts of the interior of the nose are successively brought into view. Any secretions that obstruct the view should be removed by means of

the atomizer or forceps, or wiped away with cotton wrapped on the end of an applicator; and any change in the bulk of the parts should be tested with the probe, in order to determine its density. If an anterior hypertrophy obstructs the view of deeper structures, cocain solution should be applied to reduce its size and allow light to penetrate into the deeper parts of the interior of the nose.

The first structure brought into view **by anterior rhinoscopy** is the vestibule, in which are seen a number of coarse hairs called vibrissæ, while a fold of skin or mucous membrane lies between the vestibule and the inferior meatus. To the inner side is the septum and to the outer side the inferior turbinated bone, forming the roof of the inferior meatus. Above the inferior turbinated bone is the middle meatus, roofed in above, except for the olfactory slit, by the middle turbinated bone. Through the olfactory slit in some individuals a portion of the superior turbinated bone may be seen.

FIG. 23.—Allen's nasal specula.

Posterior rhinoscopy is to all intents and purposes the same process as laryngoscopy, except that a smaller mirror must generally be used, the reflecting face of which is turned upward instead of downward. The tongue, also, instead of being drawn forward with a napkin, is held down by means of a tongue-depressor. The relative position of patient and observer is the same as in laryngoscopy, except that the patient's head is not bent backward, but is either held perpendicularly or is inclined slightly forward. The rhinoscopic mirror, having been warmed, should be introduced into the pharyngeal cavity behind the velum palati, and so placed as to reflect the light upward and forward into the vault of the pharynx and into the posterior nares (Fig. 24). For this

purpose a No. 1, 0, 00 mirror is generally most useful, but a larger mirror can sometimes be used to advantage, and should always be employed when the space between the palate and pharynx is sufficient to permit it. Posterior rhinoscopy is much more difficult than laryngoscopy; but, except in the case of young children, patience and dexterity will almost always enable the observer to obtain a glimpse

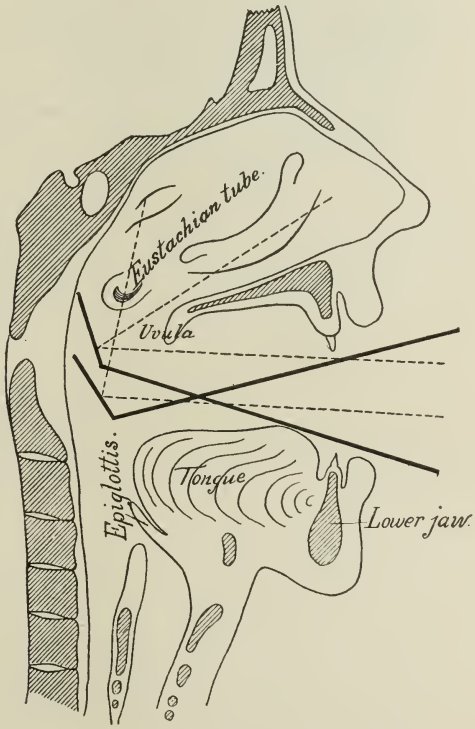


FIG. 24.—Course of light rays in posterior rhinoscopy. Sagittal section of head (Sahli).

of the various parts of the posterior nares and vault of the pharynx without the use of accessory instruments. When disease of these structures exists or posterior hypertrophies or other neoplasms are present, the examination is usually easy because of their interference with the motion of the palate

and the relatively wider space between the palate and posterior pharyngeal wall.

Obstacles to Posterior Rhinoscopy.—In many cases the palate will rise forcibly as soon as the mirror has been introduced, thus completely shutting off the view of the parts above. This difficulty can often be overcome by requesting the patient to breathe through his nose, or emit a nasal sound like that of the French letter *n*, or say "One." Some operators ask their patients to "smell," that is, to draw the breath inward forcibly through the nose as if endeavoring to perceive an odor.

The observer should in all cases avoid touching the back of the tongue or pharyngeal wall, as otherwise gagging and retching immediately occur, and further examination is rendered futile.

Occasionally a palate retractor will be convenient. Probably the best of these instruments is that of White (Fig. 25). The wire hook of the instrument is passed behind the

FIG. 25.—White's palate retractor.

soft palate, and by pulling the stem gently outward the uvula and palate are pulled into the desired position and held forward by the pressure of the wire loops, which are slid along the stem until they rest within the nose.

Posterior Rhinoscopic Image.—Except in cases of cleft palate, it is impossible to obtain a complete posterior rhinoscopic image, such as is shown in Fig. 26, but by varying the position of the mirror, the different parts may be brought into view and studied one after the other. Usually the first object seen is a triangular plate, with its apex downward—the posterior margin of the nasal septum. Above it is a mass of glandular tissue called the pharyngeal tonsil, while at each side lower down are the crater-like orifices of the Eustachian tube. In front of these, and projecting

toward the septum, are the posterior aspects of the turbinated bones. The middle turbinated bone is usually first brought into view, and rarely the dim outline of the superior turbinated bone may be distinguished above and in front of

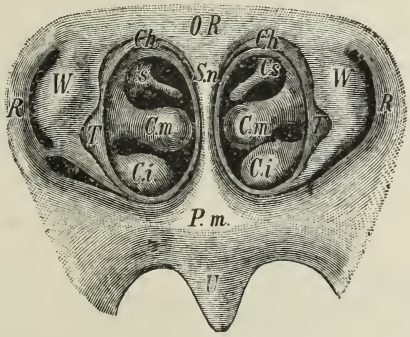


FIG. 26.—Normal picture in posterior rhinoscopy. Diagrammatic in that to obtain complete picture the position of mirror must be repeatedly changed: *S.n.*, Septum; *Ch.*, choana; *P.m.*, soft palate; *U.*, uvula; *C.i.*, lower turbinate bone; *C.m.*, middle turbinate bone; *C.s.*, upper turbinate bone; beneath each turbinated the corresponding fossa; *O.R.*, roof of pharynx; *T.*, opening of Eustachian tube; *W.*, promontory of tube; *R.*, Rosenmüller's fossa. (After Schnitzler.)

it. Below the middle turbinated bone the upper part of the inferior turbinated bone is readily perceived; but to see the lower part of this structure and the floor of the nose requires considerable practise in the use of the rhinoscopic mirror.

OTOSCOPY

Otoscopy is the art of inspecting the visible parts of the ear. Ordinarily these parts are the auricle, the external auditory meatus, and the outer surface of the membrana tympani. Deeper portions of the ear are, however, visible when the overlying structures are destroyed by disease or are removed during an operation. Generally the dim outlines of the malleo-incudal joint can be seen through a normal or atrophied drum-head, and occasionally the chorda tympani nerve and other structures.

The name **otoscope** is often applied to an instrument consisting of a hollow cylinder to one end of which ear specula of various sizes may be adjusted (Fig. 27). The side of the

cylinder is fenestrated for the admission of light, which, when the instrument is in use, falls upon a perforated mirror set at such an angle within the cylinder that the light is reflected from it through the speculum into the ear. The observer examines the condition of the parts by looking through the perforation in the mirror. An eye-piece containing a lens is adjusted to the proximal end of the cylinder to enable the observer to obtain a magnified image of the membrana tympani. This instrument has been modified by the addition of miniature electric-light bulbs and in various other ways. Although an excellent view of the membrana tympani can be obtained by means of this instrument, it has fallen into

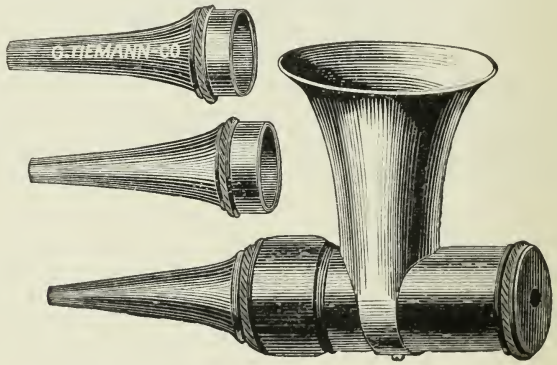


FIG. 27.—Brunton's otoscope.

comparative disuse, modern otoscopy being generally accomplished by means of a reflector and an ear speculum.

Otoscopic Reflector.—The reflector generally used to illuminate the auditory canal and its fundus is the same as that employed in laryngoscopy and rhinoscopy (Fig. 2).

The **specula used in otoscopy** are funnel-shaped instruments constructed of hard rubber or metal. Different forms are sold under the names of Wild's, Gruber's, Toynbee's, Boucheron's, Kramer's, and Politzer's specula. Gruber's specula (Fig. 28) are probably the best for ordinary purposes of otoscopy, because a transverse section of their calibre at right angles to their long axes more nearly corresponds with a similar

section of the external auditory meatus. However, Boucheron's specula (Fig. 29) are better adapted for use during an operation upon the middle ear, and with many otologists are favorite specula for purposes of inspection and treatment, because their wide proximal rims afford greater space for the manipulation of instruments, and a firmer grasp to the thumb and fingers when the instrument is held within the auditory canal. Ear specula are usually sold in "nests" of three or four sizes fitting into a case. Those constructed of hard rubber are easily broken, and those manufactured of German silver and nickel plated are necessarily thicker than is desirable; a thin, solid-silver

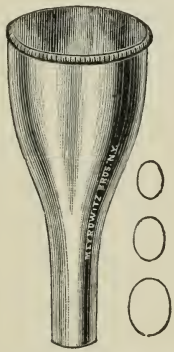


FIG. 28.—Gruber's specula.

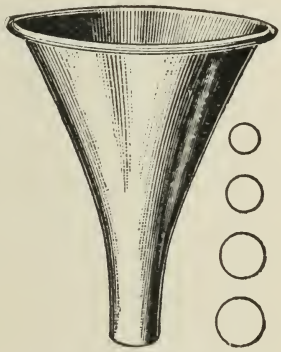


FIG. 29.—Boucheron's specula.

speculum, aside from its expensiveness, being the preferable instrument.

Relative Positions of Patient and Observer in Otoscopy Conducted with the Reflector and Speculum.—The patient and observer may both stand in front of a window or the source of artificial light, or both may be seated upon piano stools so adjusted that the eye of the observer and the ear of the patient are in the same horizontal plane. The ear to be examined should be directed toward the observer, and the patient's face turned somewhat away from him, because the auditory canal generally extends in a direction inward, forward, and somewhat downward. If the reflector is worn upon the forehead, the source of light should be above or

to one side of the patient's head, and so placed as to throw the auricle into the shadow. The light concentrator, with reflector, shown in Fig. 4, may be used for otoscopy, the reflector so adjusted between the observer and patient that it will illuminate the fundus of the auditory canal.

To **introduce the speculum** the observer should first direct the light from the reflector upon the orifice of the meatus, and then straighten the auditory canal by gently drawing the auricle upward, backward, and slightly outward, at the same time endeavoring to see the drum-head without the use of a speculum. In many instances this can be accomplished satisfactorily, especially in negroes, in whom the canal is usually straight and large. Under such circumstances the observer should not be in haste to introduce the speculum, as it may dislodge and push into the field of view a flake of wax or epithelium, which will greatly interfere with a distinct view of the membrana tympani. The auditory canal having been straightened in the manner described and the parts being fully illuminated, the speculum is held by its rim with the thumb and finger and gently introduced with a slight rotary motion into the auditory canal, in such a manner that its long axis exactly corresponds with that of the canal. The greatest care should be exercised in introducing the speculum not to use it as a lever in such a manner as to bring its sharp edge in contact with the wall of the canal and cause pain; obstruction to the progress of the speculum being overcome by moving the whole instrument in a direction opposite to that in which the obstruction is felt until the membrana is brought into view, when the speculum may, if necessary, be retained in position by grasping it and the auricle in the manner shown in Fig. 30.

Obstacles to Otoscopy.—The chief obstacle to the beginner is caused by so misdirecting the long axis of the ear speculum that it does not correspond with the long axis of the auditory canal, so that a portion of the auditory canal is brought into view or only a portion of the membrana is seen. Under such circumstances the end of the speculum within the ear should be moved about until a satisfactory view of the drum-head has been obtained. Generally it

will be found that the cause of failure has been that the axis of the speculum has been directed too far backward and upward.

Another cause of difficulty is excessive sensibility of the auditory canal or swelling of its walls, the result of diffuse

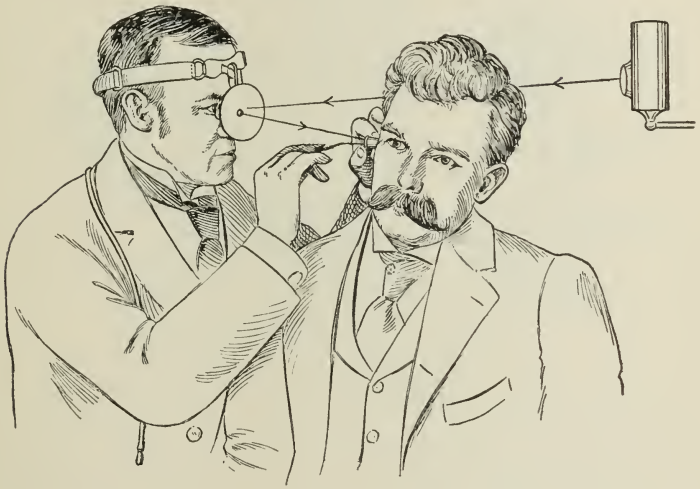


FIG. 30.—Otoscopy with the reflector and ear speculum. The arrows represent course of light.

inflammation. Sometimes a satisfactory view of its deeper parts can be obtained under such circumstances by gentle and persistent effort, a small speculum being used to dilate the auditory canal.

Siegle's pneumatic speculum (Fig. 31) is an air-tight chamber to which specula of various sizes can be attached by means of a screw-joint. The side of the air-tight chamber carries a perforated knob, over which is slipped a rubber tube terminating in a rubber bulb. The proximal end of the instrument is glazed either with plane glass or with a convex lens set at an angle of 45 degrees with the long axis of the instrument. When the instrument is in position within the auditory canal, the surgeon is enabled to judge of the mobility of the whole or of a part of the membrana tympani by observing its movements during condensation and rare-

faction of the air in the auditory canal brought about by the action of the surgeon's hand upon the rubber bulb. Before using the instrument it is well to slip a short piece of wet rubber tubing over the end of the speculum to ensure its fitting into the auditory canal as nearly air tight

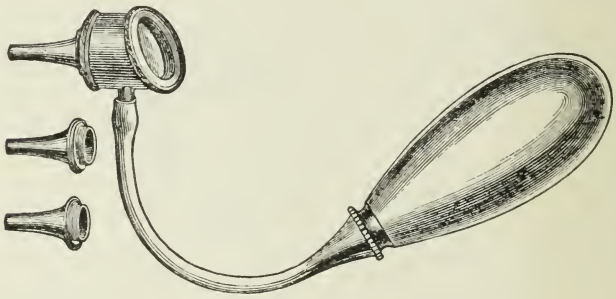


FIG. 31.—Siegle's pneumatic specula.

as possible. When the Eustachian tube is impervious to air the pneumatic speculum furnishes the only means of determining the mobility of a part or the whole of the membrana tympani.

Instead of using a rubber bulb to produce rarefaction and condensation of the air in the auditory canal, a *piston-syringe* may be employed or the *masseur of Delstanche*. This instrument (Fig. 32) has a spring inside the barrel by which the piston is forced outward. By means of a screw the length of the movements of the piston and hence the degree of rarefaction and condensation of air in the auditory canal can be modified to suit individual cases. The masseur of Delstanche is a useful instrument, but probably of no more practical utility than the simple rubber bulb when employed by a judicious operator, for it should be borne in mind that it is entirely possible to rupture some membrana tympani by too vigorous use of aural massage.

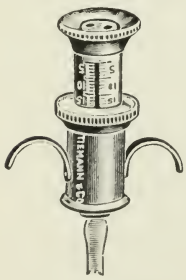


FIG. 32.— Masseur of Delstanche.

Machines similar to Fig. 33, whose motive power is compressed air, electricity, or a water motor, are sometimes employed. They yield more rapid rarefaction and con-

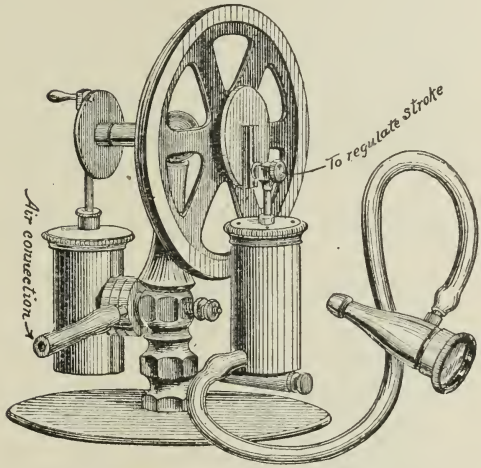


FIG. 33.—Aural masseur (*Jour. of Laryngol., Rhinol., and Otol.*, Jan., 1902).

densation of the air of the auditory canal than the hand bulb and occasionally may prove more useful.

ACCESSORY INSTRUMENTS

The **laryngeal sound** consists of a piece of silver wire, rounded at one end and inserted in a universal handle (Fig. 1). It should be sufficiently long to reach the anterior angle of the glottis without bringing the fingers holding the handle into the patient's mouth, and thus obstructing the view, and sufficiently firm to resist a considerable amount of pressure without bending.

The **cotton applicator** consists of a piece of aluminum or, better, copper or iron wire of about the same size and length as the laryngeal probe, with roughened ends; so that a piece of absorbent cotton can be tightly wrapped around one end without fear of its becoming loose. This tuft of absorbent cotton will carry enough solution for any application within the laryngeal or postnasal cavities. For

applications to the nasal cavities smaller instruments are desirable, and Allen's applicator (Fig. 34) is better adapted for this purpose. Allen's probe (Fig. 35) consists of a conic piece of soft, malleable steel wire fitted into an aluminum handle. It is extremely light and delicate, and may be used either for the nose or for the ear. When used as a probe, a few fibers of absorbent cotton are wrapped about its tip, in order to cover its sharp extremity. The tip of the instrument can be bent into the form of a hook to bring forward nasal polypi or ascertain their place

FIG. 34.—Allen's nasal applicator.

of origin, the thickness of their pedicle, etc., or to probe the attic of the tympanum. The presence of exposed bone is readily detected by the spicules catching in the cotton fibers and imparting a characteristic resistance. It also may be used for the application of chromic acid and other caustics, which are either fused upon the tip of the probe, or the coarsely powdered particles of the caustic may be entangled in a few fibers of moist cotton wrapped about the tip, and thus safely conveyed to the location within the nose where the cauterization is to be made.

FIG. 35.—Allen's probe.

The Atomizer.—In most forms of throat and nasal disease sprays are extremely useful, not only to cleanse the parts and remove accumulated secretions, but also as a means of spreading medicated solutions over a large surface. For laryngeal and postnasal use and as an atomizer, to fit into the rhinologic instrument bag for use in treating patients at their homes, the DeVilbiss atomizers are probably the best, as they throw a fine spray either upward or downward or straight forward. The "Magic atomizers" are, however, preferable for washing out the anterior nasal cavities, and as a "prescription" atomizer for patients' use.

The air-current necessary to produce the spray from atomizers may be supplied either by a rubber hand-bulb or an air-compressing apparatus.

In spraying the nose, pharynx, or larynx with a hand atomizer, the bottle of the instrument should be grasped between the thumb and first finger of the right hand with the rubber bulb in the hollow of the hand. The rubber bulb can then be pressed by the three remaining fingers with sufficient force and rapidity to give a continuous spray. This method of employing the atomizer leaves the left hand

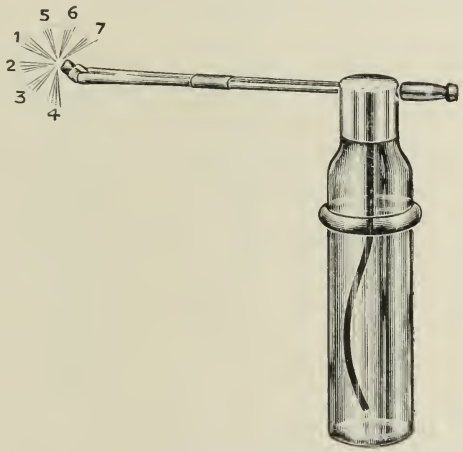


FIG. 36.—Atomizer.

free to elevate the tip of the nose or manipulate a tongue-depressor. In spraying the nasal cavities the tip of the nose should be elevated with the finger and thumb of the left hand, and the end of the atomizer should rest against either the thumb or finger of the operator, and not the rim of the patient's nose. The use of this method will prevent the necessity of sterilizing the end of the atomizer tubes each time they are used upon a patient.

Because secretions tend to gravitate toward the floor of the nose, especial attention should be directed toward the *inferior meatus* in washing out the interior of the nose. It is a good plan to tip the head of the patient slightly back-

ward and direct the spray from the atomizer somewhat downward, that is, in a direction toward the lobe of the ear. Under such circumstances the nasal secretions that have accumulated on the floor of the nose are readily washed into the pharynx and are hawked down and expectorated. The stream of the atomizer can then be directed to any portion of the upper part of the nose which, on inspection, appears covered by semi-inspissated secretions.

For washing out the *postnasal space* an atomizer throwing a spray straight forward through the nose is generally

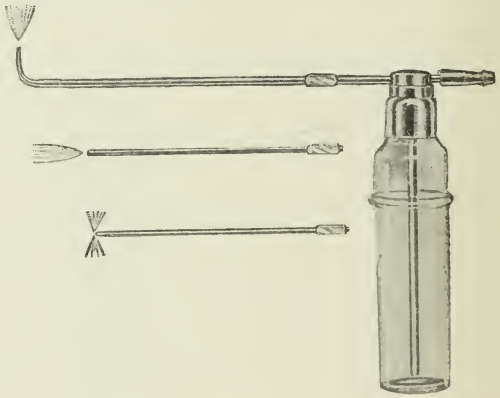


FIG. 37.—DeVilbiss atomizer No. 54. One of the tubes is only $\frac{1}{16}$ inch in diameter and throws a spray in four opposite directions. It can be easily carried through the nares into the pharyngeal vault in the same manner as an Eustachian catheter. The postnasal space can be successfully treated, when an atomizer introduced into the throat of a patient would cause repeated gagging. It is excellent for washing out or making applications to the nasal cavities. It has a tube that may be turned so as to spray the tonsils or carried behind the soft palate for making applications direct to the vault of the pharynx and postnasal cavities. This atomizer has no inner tube that is liable to become clogged.

sufficient; but in cases where partially dried and glue-like secretions are very adherent, the atomizer with a tip turned upward answers a useful purpose (Fig. 37). The atomizer's tubes are introduced through the mouth behind the soft palate, and the patient's head is bent forward over a bowl. The spray from the atomizer should be very coarse and applied with considerable force. Under such circumstances a stream of fluid and mucus flows from the anterior nares into the bowl, or the masses of glue-like mucus adhering

to the pharynx are dislodged by the coarse spray, and afterward hawked down and expectorated.

However, such masses of mucus are more readily removed from the pharynx by means of solid streams of fluid than by the coarsest spray from an atomizer. Therefore

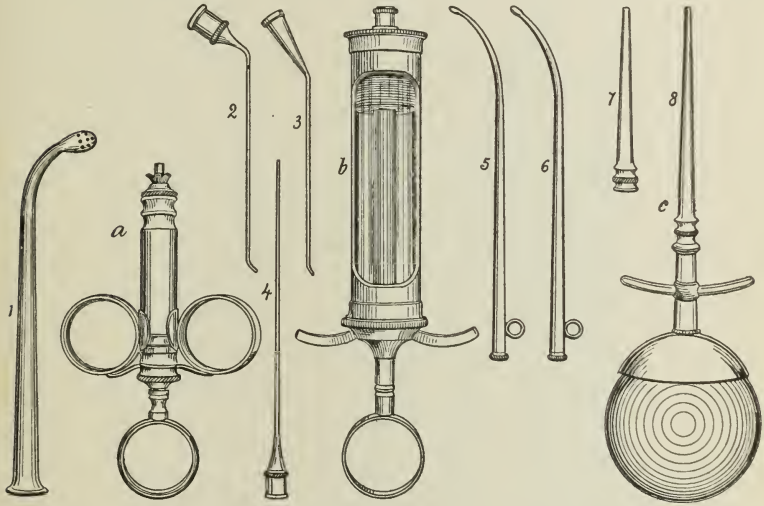


FIG. 38.—Syringes with interchangeable nozzles: *a*. Syringe of ½-dram capacity for cleansing and applying solutions to the attic by means of Blake's cannula (2, 3, and 4). Also for making applications to the Eustachian tube by means of nozzle 7 and an ordinary Eustachian catheter. *b*. Antitoxin syringe, holding 2½ drams. May be used with Blake's cannula for cleansing middle ear or with postnasal nozzle (1) for cleansing the posterior nares. It is convenient where the operator prefers a piston- to a bulb-syringe. *c*. Dentists' tooth syringe, capacity 1 ounce. This is probably the best syringe for removing impacted cerumen and for coarse syringing of the auditory canal. When fitted with a moderately large long silver nozzle (4) any of the accessory cavities of the nose that can be probed can be washed out through their anatomic orifices. For this purpose the silver nozzle should be made of pure silver, so that it can be bent readily to the requisite curve, and the operator should be provided with four or five such nozzles about 5 inches long and of the diameter of Nos. 3, 5, 6, and 8 of the French catheter scale. Instead of these silver nozzles an Eustachian catheter may be employed, or the nozzles 5 and 6, fitting on to the nozzle 7, which screws on to the syringe when nozzle 8 is unscrewed. It is well for the operator to be provided not only with several sizes of the straight cannula (4), but also with several sizes of Blake's cannula (2 and 3), to be used with this syringe or syringe *b*.

the syringes (Fig. 38, *b* or *c*, with postnasal tip 1) for cleansing the nasopharynx generally are more useful instruments. The tip is introduced behind the palate, the patient then leans forward over a bowl. The streams or stream of fluid is thrown with sufficient force into the postnasal space to

dislodge the masses of mucus from the pharynx, and wash them forward through the nose into the bowl.

When an atomizer is prescribed for a patient's use at home, the object that the surgeon wishes to accomplish should be carefully explained to the patient and he should be instructed in the use of the atomizer and also how to keep the instrument in good order. If this is not done, the patient's use of the atomizer at home will amount to practically nothing. For example, if an atomizer and a detergent spray, such as Dobell's solution, is prescribed with the main object of cleansing the nose, the patient should throw his head back and point the beak of the atomizer downward (not upward), so that the main force of the spray will be directed along the floor of the nose into the nasopharynx. It should be demonstrated to the patient so that he thoroughly understands that if while he is using the atomizer he breathes gently through his nose the spray will pass downward behind the relaxed palate into his mouth and can be expectorated. That, on the contrary, if he holds his breath, the fluid will be retained in the nasopharynx upon the contracted palate and will run out of his nose as soon as his head is lowered, with the result that the nasopharynx is not as efficiently cleansed as would otherwise be the case.

The interior of the *nasal cavities* can be cleansed as thoroughly by means of a hand atomizer as by means of an atomizer whose spray results from the use of the most expensive of air-compressing apparatus; but the latter are convenient, and where a large number of patients are to be treated save the surgeon's hand the fatigue that would result from long-continued use of the hand atomizer.

There are a large variety of *air compressors* for sale in the instrument stores, and it is difficult to state which one is the most practical and useful. Fig. 39 shows a fairly good apparatus for use when the amount of compressed air required is by no means great.

However, the most satisfactory apparatus for furnishing compressed air is a *water air-pump*, such as is used by saloon-keepers for forcing beer and ale from the barrels in the cellar into the faucets in the bar-room. The water-pump is attached to a water-pipe in such a manner that water may

run through it and flow into the waste-pipe or sewer. It is automatic and continues in operation until the air-pressure in the receiver equals that of the water in the supply pipe. The Buck Eye and some other pumps furnish an air-pressure double that of the water in the supply pipes, but are proportionately slow in their action. The Champion and Little

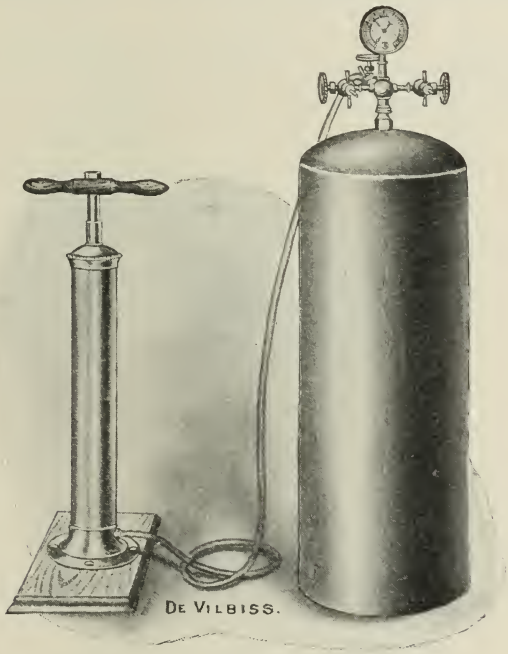


FIG. 39.—De Vilbiss' compressed-air atomizing apparatus.

Wonder (Fig. 40) pumps are rapid and effective instruments for furnishing practically an unlimited supply of compressed air at the same pressure as the water in the supply pipes.

As an air receiver, when one of these pumps is used, an ornamented copper cylinder may be placed in the surgeon's office; but nothing answers the purpose better than an ordinary galvanized wrought-iron cylinder or "boiler," such as is found in most American kitchens, as a reservoir for hot water as a part of the so-called "circulating boiler" apparatus for supplying hot water for domestic pur-

poses. The water air-pump may be attached to the water pipes underneath the sink in the physician's office, and the air receiver placed down cellar, or both pump and air receiver may be placed in the cellar should the plumbing permit of such an arrangement. Whatever the position of the air receiver, a pipe or tube should lead from it to a stop-

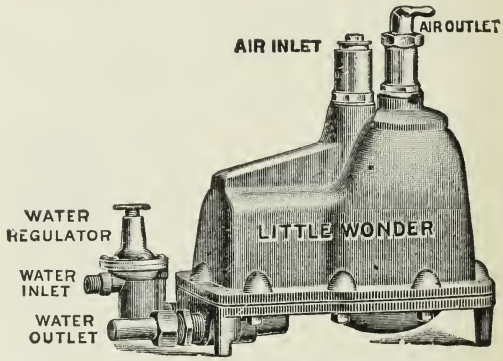


FIG. 40.—The Little Wonder pump

cock upon the wall, immediately at the side of or beneath the adjustable gas bracket (Fig. 41). Attached to the stop-cock there should be a rubber tube three or four feet in length, terminating in an automatic cut-off (Fig. 42). When compressed air is used for other purposes than supplying an air-current for atomizers, the pipe from the air receiver should

FIG. 41.—Six stopcocks on oil-finished walnut board, to connect with air receiver by tubing with stopcock A. In this way various atomizers or medications can be readily used It is made to fasten on wall by screws.

terminate in a bracket of stopcocks from which rubber tubes lead to the nebulizer, the aural masseur, etc. The automatic cut-off is an instrument by which compressed air is conveniently supplied to an atomizer. The end of the instrument (*a*) is attached to the rubber tubing of the compressed-air apparatus, and the nozzle (*b*) of the instrument inserted

into the hole in the nipple of the atomizer, from which the hand-bulb previously has been removed, and by pressing down the lever (*c*) a current of compressed air is forced through the atomizer in the same manner as if a rubber hand-bulb were used. The current of air ceases as soon as the lever is released. In using the automatic cut-off, the atomizer is held in the right hand and the lever of the automatic cut-off pressed downward by the thumb.

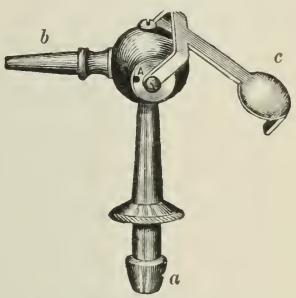


FIG. 42.—Boekel's automatic cut-off.

Sinks.—A most convenient adjunct to a laryngologist's office is a sink. It should be supplied with hot and cold water. There have been a number of sinks manufactured for the use of physicians and hospitals. The best of these are constructed of white enameled iron, and the flow from the spigot is controlled by foot levers. This arrangement prevents the necessity of turning off the water with the hands after they are washed.

A *swinging spittoon* may be attached to the sink or wall in such a manner that it can be swung out of sight when not in use. A water spittoon such as is employed by dentists is not more convenient but certainly looks better than even the most ornamental receptacle for expectorations, and although bulky adds somewhat to the appearance of care and neatness about the office.

Pynchon's cabinet (Fig. 43), for instruments, linen, etc., is a convenient office accessory. It is provided with 18 drawers of different sizes (each partitioned to accommodate regular and special instruments) and compartments for clean and soiled linen, that for the latter having ventilators in both front and back. The clean linen compartment has a glass shelf and beveled plate-glass door. In addition to these there is a compartment provided with a swinging glass tray which, when fully drawn out, discloses another drawer.

The **nebulizer** (Fig. 44) is indispensable because vapors will penetrate where fluids and the spray from an atomizer

will not. These instruments, therefore, are useful in the treatment of diseases of the middle ear and the accessory cavities of the nose and the smaller bronchial tubes.

Nebulizers are manufactured in many styles, from the single nebulizer, for patients' use at home, to more elaborate instruments for office use, like that shown in Fig. 44, which consists of a number of nebulizers connected together in such a manner that one or more can be utilized at a time. The vapor from each vaporizer when in use passes through

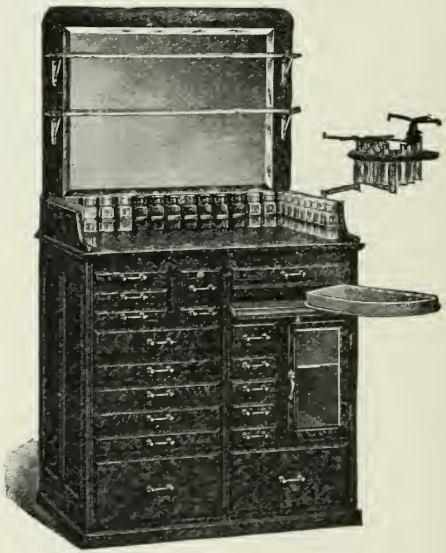


FIG. 43.—Pynchon's cabinet.

the mixing bottle shown in the center of the cut, and when two or more vaporizers are used at the same time their combined product is blended in the mixing bottle before being inhaled by the patient. A valve (*V*, Fig. 44), worked by the thumb or finger in the same manner as the automatic cut-off, permits inflation of the middle ears and accessory nasal cavities, and by rapidly moving this valve successive jets of vapor, as it were, may be thrown into these cavities, massaging the mucous membrane of the accessory cavities and the intratympanic structures. When used for this

purpose, the nose-piece of the instrument is inserted into the patient's nose and he is told to puff out his cheeks. Puffing out the cheeks causes the soft palate to rise, and shuts off communication between the nose and nasopharynx with the rest of the respiratory tract. If now the valve *V* be pressed upon by the finger, the nebulized vapors enter the nose, its accessory cavities, and the middle ear. By rapidly working the valve *V*, the pressure of the vapor within these cavities is alternately increased and decreased and the mucous membrane massaged. Excessive pressure within

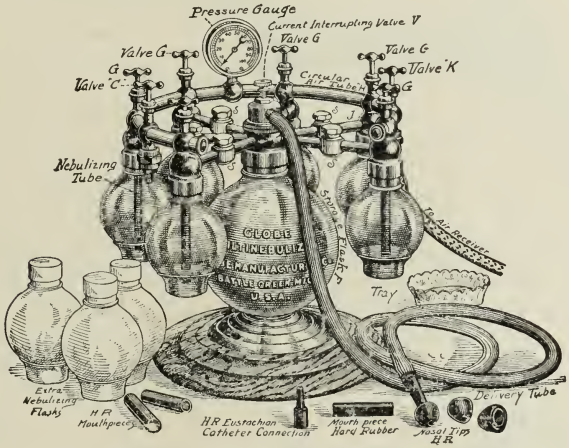


FIG. 44.—Six-flask Globe multinebulizer.

the middle ear can be prevented by the patient stopping his auditory canals with the finger-tips.

Inhalers are mostly employed for the inhalation of the vapors of a drug suspended in hot water. The simplest form of this instrument is the bottle-inhaler, to be found for sale in most drug-stores. It consists, in its simplest form, of a wide-mouthed bottle, through the cork of which two glass tubes are thrust. One reaches nearly to the bottom of the bottle; the other passes simply through the cork, and is bent at the upper extremity. The bottle is filled one-third full of a solution, and the patient, by inhaling through the bent glass tube, causes air to bubble through

the fluid and become impregnated with the volatile substances in the fluid before being drawn into the lungs. Compound tincture of benzoin (1 teaspoonful to the inhaling bottle one-third full of hot water) is a domestic remedy of considerable reputation and some value in inflammation of the upper respiratory tract.

The Powder-blower.—Remedies are often applied to the interior of the nose and larynx in the form of an impalpable powder. For this purpose the instruments shown in

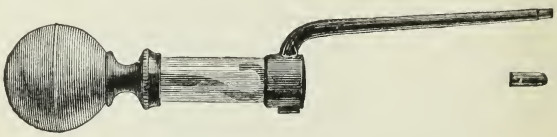


FIG. 45.—Davidson's reservoir powder-blower. The instrument is also made with a curved tip.

Figs. 45 and 46 will be found useful. The reservoir insufflators of DeVilbiss and Davidson are very convenient instruments, which obviates the necessity of loading the powder-blower each time that it is used. However, they have the disadvantage of sometimes becoming temporarily

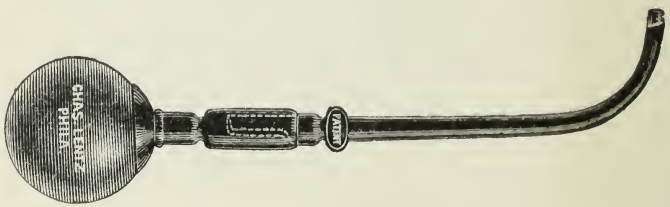


FIG. 46.—Powder-blower.

clogged, and at the next attempt to use them discharge a much larger quantity of powder than is required into the patient's air-passages. Sometimes a very large amount of powder will be unexpectedly thrown into a patient's larynx from this instrument, causing momentarily great distress and severe laryngeal spasm, which, however, quickly subsides if the patient is given a glass of water to drink and told to hold his breath for a moment. Such accidents can, however, be avoided by care on the part of the operator.

The Hot-air Apparatus.—Hot air is occasionally beneficial in the treatment of diseases of the upper respiratory tract and middle ear. It allays the swelling and irritation and decreases the blood-pressure. It is especially useful in acute inflammatory diseases of the accessory sinuses and middle ear, although the relief is often more transient than

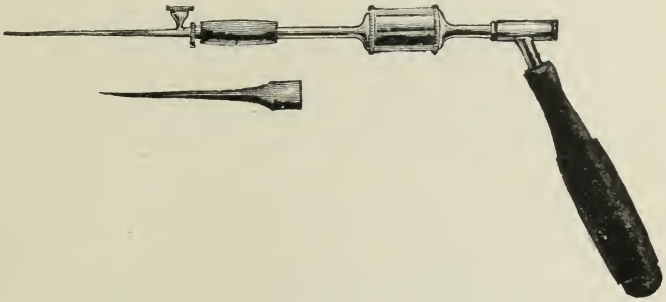


FIG. 47.—Van Sant's hot-air apparatus.

permanent. An effective method of application is the hot room of a Turkish bath. The modification of an apparatus used by dentists for drying tooth cavities (Fig. 47) or more elaborate apparatus, in which air is heated by an electric current, are occasionally useful, as they permit a continuous current of hot air to be thrown on inflamed tissue in any

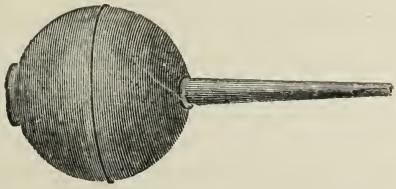


FIG. 48.—Soft-rubber eye, ear, and ulcer syringe.

portion of the mouth, nose, or auditory canal. Sometimes it affords at least temporary relief from the pain and tinnitus of acute middle-ear catarrh. The apparatus shown consists of a cylinder of brass in which is enclosed a piece of gas carbon, and so constructed that it fits into a handle. The cylinder is heated over a Bunsen burner and the automatic

cut-off attached to the handle. Air passing through the apparatus from the cut-off is heated as it passes around the gas carbon, and may be conveyed to the desired locality of the patient's nose, throat, or ear by means of one of a set of detachable end-pieces.

For the patient's use at home the eye, ear, and ulcer syringe of the Davidson Rubber Co., made of one piece of soft rubber (Fig. 48), answers a useful purpose for syringing the nose or for the aurist's use in syringing mastoid wounds. The nozzle of the syringe is made of soft rubber, and hence it can be inserted in the auditory canal or a mastoid wound without danger or pain.

STERILIZATION OF INSTRUMENTS

All instruments used in operations upon the nose, throat, or ear should be carefully sterilized by boiling in a 5 per cent. bicarbonate of sodium solution. After an operation the instruments are placed in a tray and soaked for five minutes in order to dissolve the dried blood adhering to them. Hot water should not be used for this purpose, as it coagulates the albumin of the blood and renders it more difficult to remove. The instruments are then scrubbed with hot water and soap. If they need polishing, sapolio or a fine sand-soap should be used. They are then boiled for five minutes in a 5 per cent. solution of sodium bicarbonate and rapidly dried while still hot in order to prevent rusting.

For the rapid drying of larger instruments, wiping with a sterile towel while the instruments are still hot answers every purpose. For smaller instruments and those with delicate joints—cannula, snares, etc.—it is better after boiling to wipe them with a towel and then immerse them in 95 per cent. alcohol for a minute or two. They should then be carefully wiped with a towel, so that every particle of moisture is removed by the wiping and the evaporation of the alcohol.

Instruments for examination and treatment, such as tongue-depressors, specula, probes, applicators, etc., are used so frequently during the office hours or in dispensary work that (unless the surgeon possesses a large stock of these articles

that can be boiled at the beginning of the hour in sufficient numbers to furnish each patient a special instrument without exhausting the supply) they are best sterilized by burning with wood alcohol. This method has the advantage that it takes but a moment and can be done in the presence of the patient, who is thus assured beyond peradventure that only sterile instruments have been used in the diagnosis and treatment of his case.

The operator should be provided with two white enameled steel trays. Into the first of these should be placed instruments for the examination and treatment of a patient. Over the instruments should then be distributed a teaspoonful or two of wood alcohol, which is then lighted with a

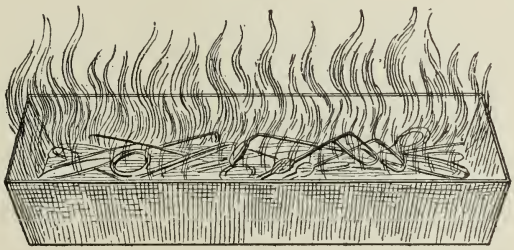


FIG. 49.—Sterilizing instruments by flaming with alcohol.

match. The flame lasts but for a moment, but the instruments are heated far above the temperature of boiling water and are, of course, rendered absolutely sterile.

Small instruments treated in this manner cool almost as rapidly as they are heated. Larger instruments, like tongue-depressors, retain their heat for an inconvenient time, and it may be necessary to cool them by dipping them in water, spraying them with an atomizer containing an alkaline wash, or pouring a little grain alcohol over them. As the instruments are used they are placed in the second tray, and are sterilized in the same manner before being again employed.

The disadvantages of the method are that it cannot be used for small aluminum instruments or those soldered with soft solder and that it soon tarnishes the instruments.

Syringes, soft-rubber tubes, hard-rubber nozzles, and

glass instruments are best sterilized by soaking them for five or ten minutes in a 5 per cent. aqueous solution of formalin (40-volume aqueous solution of formaldehyd gas). The barrel of the syringe should be filled with the solution and the entire syringe immersed. If the syringe is sterilized in this manner immediately before being required it should be carefully rinsed in sterile water before being used to prevent the irritating effects of formalin, for it should be borne in mind that even very dilute solutions of formaldehyd gas are very irritating to the mucous membranes of the nose, throat, or middle ear.

Atomizers should be used in the manner previously described, so that the tips never come into actual contact with the patient on whom they are used. When made with interchangeable tips the extra tips may, of course, be kept in an antiseptic solution, that of formaldehyd being perhaps the most reliable.

Although boiling in sodium bicarbonate solution and the other methods of disinfection described above are reliable, it is advisable for psychologic reasons at least to have a special set of instruments for syphilitics and another special set for those with tuberculosis.

Preparation of Operator.—Before operating on the nose or throat the surgeon should prepare himself, as for any other operation, by scrubbing his hands and arms with green soap, rinsing in alcohol, and immersing his hands in bichlorid solution, or prepare himself by any other method he has found satisfactory.

Sterilization of Nose.—Unfortunately we do not possess a reliable antiseptic for sterilizing the nose or nasopharynx. Any solution of carbolic acid (probably the most sedative to mucous membranes of the common antiseptics) strong enough to kill bacteria would excite a local inflammation that would interfere greatly with the rapid healing of the operative wound. The same remark applies in still greater degree to the other antiseptics. However, before an operation the mucus membrane should be freed, especially in atrophic cases, from adherent mucus by an alkaline spray or, if this is not sufficient, an alkaline spray to which peroxid of hydrogen has been added.

EXAMINATION OF PATIENTS

First listen passively to the patient's story of his illness; asking judicious but not leading questions, so as to elicit the facts of the case, such as the influence of his employment upon his health or any inherited tendency that he may have toward disease of the nose, throat, or ears, cause of the disease, the length of time that it has continued, and the symptoms other than disease of the nose, throat, or ears that may be present. In questioning the patient the physician should bear in mind the effects of "suggestion" upon patients of nervous temperament as regards tinnitus. Many neurotics with disease of the middle ear will experience for the first time subjective noises in their ears upon being asked leading questions in regard to tinnitus, and afterward complain of the presence of this symptom, which previous to that time had not attracted their attention.

Careful notes of the patient's history should be made in the case-book, and especial prominence be given to the symptoms of the disease from which he seeks relief.

Examine the **tongue**, as to whether coated or clean, pale or flabby, or of a natural color and resistance; look for ulcerations or mucous patches upon the tongue or the inside of the mouth; and also notice the shape and condition of the teeth. Having depressed the tongue, observe the palate and uvula, the anterior pillars and tonsils, the posterior pillars and posterior pharyngeal wall. Notice any change from the natural color, shape, or mobility of the parts, the presence or absence of foreign bodies or hardened secretions.

The **nose** should next be examined by anterior and posterior rhinoscopy and, finally, the laryngeal mirror should be introduced. In these examinations, notice the condition of the parts in the following order, viz.: (1) Color and condition of the mucous membrane; (2) size and shape of the part examined; (3) loss of substance by ulcers, etc.; (4) presence of foreign bodies, neoplasms, or accumulated secretions; (5) mobility of the parts and functional disturbances. During the examination touch any suspicious swelling with the probe, so as to ascertain its mobility, and

whether it is composed of bone, cartilage, or softer structures. As the examination progresses, the result should be jotted down in the case-book, and any deviation from the normal in size or shape, or the presence of neoplasms or foreign bodies, sketched upon the margin of the page.

In cases complaining of aural disease the **hearing** should next carefully be tested by the voice, the watch, and the tuning-fork. In making a record of the results of the tests for hearing it is convenient, to facilitate easy reference at a subsequent period, to devote one or more lines in the note-book to each ear, using abbreviations to economize space; for example, as follows:

A. D. (Auditus Dextra) or R. E. (Right Ear).	H. (Hearing).	V.=whisper, 3 ft. (Voice).	W.=$\frac{12}{36}$. (Watch).	T.-F. c_2, vertex best in (Tuning-fork).	A. S.	M.=$\frac{20}{30}$. (Mastoid).	M. A. $\frac{10}{40}$. (Meatus Auditorius).
A. S. (Auditus Sinistra) or L. E. (Left Ear).	H. (Hearing).	V. = (Voice).	L. C. 6 ft. (Loud Conversation).	W.=$\frac{24}{36}$. (Watch).	T.-F. c_2. (Tuning-fork).	M.=$\frac{40}{30}$. (Mastoid).	M. A. $\frac{20}{40}$. (Meatus Auditorius).

In the above record of the tests of the hearing power it will be noticed that bone-conduction, as tested by a c_2 fork, is somewhat impaired for the right ear and apparently increased for the left, indicating, as previously explained, that there exists in the right ear not only disease of the conducting apparatus, but also impairment of the receptive apparatus. For most cases one tuning-fork, preferably a large c_2 fork, is all that is required; but for reasons previously stated the aurist should be provided with at least five forks—C, c, c_2, c_3, c_4—which should all be used in testing the hearing in certain cases apparently demanding operative interference, in order to ascertain the probable result upon the hearing.

After the hearing has been tested the aurist should inspect the parts of the **ears** made visible by means of otoscopy, carefully noting the condition of the external auditory canal and drum-head; and if the membrane be wholly or partly destroyed as the result of disease or

auditory canal and drum-head; and if the membrane be wholly or partly destroyed as the result of disease or

accident, noting the condition of the mucous membrane of the tympanum and other structures that may be visible. In most instances it is advisable to make a diagram or rude drawing of the condition of the tympanum, and in making notes as to the results of otoscopy to give one or more separate lines in the note-book in the same manner as when recording the results of the tests for hearing.

The patency of the **Eustachian tubes** should next be tested by means of the Politzer method and the aural stethoscope or, if necessary, the Eustachian catheter should be used.

In many cases it is neither necessary nor desirable to make as elaborate an examination as that described above. Dr. Rohrer's diagnostic table, here inserted, although too elaborate for daily use, will be found convenient for reference, and from it as a model a less complicated page may be constructed if the physician desires something of the kind on which to keep notes of his cases. The writer, however, after using for some years a somewhat elaborate record book, now uses a card-index, with simple plain cards, for his case records.

THE NOSE

ANATOMY OF THE NOSE

THE **external nose** is an arch-shaped framework, bony above and cartilaginous below, covered by integument externally and lined within by mucous membrane. It is separated into two portions, practically two noses, by the *nasal septum*.

The **bony arch** or bridge of the nose (Fig. 50) is composed of the nasal processes of the superior maxillary and the nasal bones.

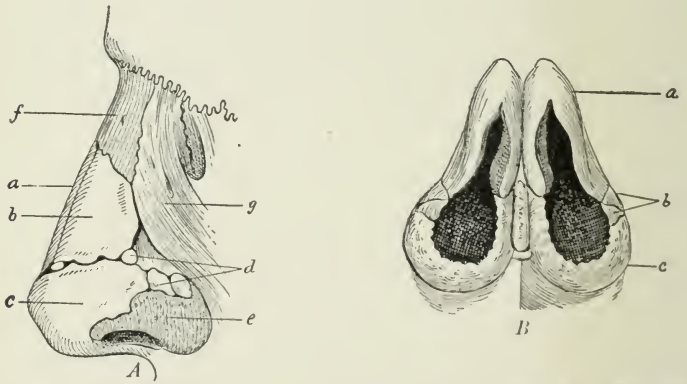


FIG. 50.—Bones and cartilages of the external nose. A, Side view: *a*, Cartilage of septum; *b*, upper and (*c*) lower lateral cartilages; *d*, sesamoid cartilages; *e*, cellular tissue; *f*, nasal bone; *g*, nasal process of superior maxillary bone. B, View from below: *a*, Lower lateral cartilage; *b*, sesamoid cartilages; *c*, cellular tissue.

The **cartilaginous arch** consists of the upper and lower lateral cartilages and the *sesamoid cartilages*, usually three on each side of the nose. The cartilages are bound together by strong connective tissue, and by the action of muscles upon them the opening into the nose can be dilated or narrowed.

The *alæ* or wings of the nose contain no cartilage, but consist of a mass of cellular tissue and fat.

The *nasal septum* consists of bone and cartilage covered by mucous membrane. Its cartilaginous portion is the so-called *triangular cartilage*, because it fits into a triangular space between the perpendicular plate of the ethmoid and the vomer (Fig. 51). However, the cartilage of the septum

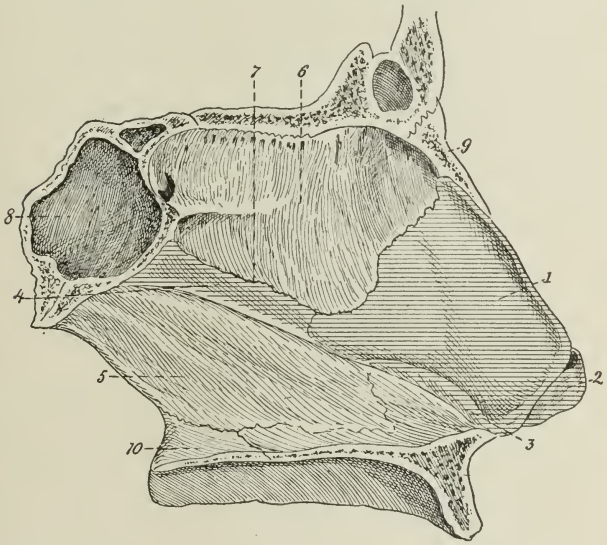


FIG. 51.—Osseous and cartilaginous septum of the nose: 1, Triangular cartilage of the septum; 2, median plate of the lower lateral cartilage, sometimes called columnar cartilage and cartilage of the aperture; 3, cartilage of Jacobson; 4, supravomerine cartilage sometimes present; 5, vomer; 6, perpendicular plate of ethmoid; 7, ethmovomerine suture; 8, sphenoidal sinus; 9, nasal bone; 10, palate bone. (Arnold.)

is quadrilateral in shape. Besides the perpendicular plate of the ethmoid and the vomer, the nasal crests of the superior maxillary, palate, and nasal bones, as well as the nasal spines of the superior maxillaries, enter into the formation of the septum, the rest of the septum fitting into a groove between these two sets of processes. The nasal septum is covered by mucous membrane, beneath which, near the nasal floor, is ill-developed erectile tissue, and above which are the specialized nerve-filaments of the sense of smell.

The *skin* covering the external nose, especially at the tip, is rich in sebaceous glands, the contents of which when diseased form the well-known comedones. At the tip of the nose beneath the skin is a cushion of fat which when hypertrophied aids in the production of "pug nose." The skin extends into the nose nearly to the anterior extremities of the inferior turbinated bones, and at the entrance into the nares it is usually covered with short thick hairs, the vibrissæ.

The *muscles* of the external nose are the levator alæ nasi, depressor alæ nasi, levator alæ nasi props, and the musculis apicis. These muscles by their action dilate and make narrow the anterior nares during respiration.

The *arteries* of the external nose are the lateralis nasi, a branch of the facial, nasal branches of the ophthalmic and infra-orbital, and the septal artery from the superior coronary artery.

The *nerves* of the external nose are branches from the facial, infra-orbital, infratrochlear, and the nasal branch of the ophthalmic.

The **nasal cavities** are the commencement of the upper respiratory tract. They extend from the anterior nares to the posterior wall of the pharynx, and consist of two chambers, divided from each other by the septum. The floor is separated from the roof of the mouth by comparatively thin structures and hence is parallel to it. The roof is formed by the nasal bones and nasal spines of the frontal bone, the horizontal plate of the ethmoid, and the anterior wall of the sphenoidal cells. The lateral walls are formed by portions of the frontal, lacrimal, ethmoid, and sphenoid bones.

Upon the lateral walls of the nasal chambers are the superior, middle, and inferior turbinated bones (Fig. 52). The *inferior turbinated* is a separate bone, but the *superior* and *middle turbinated* are portions of the ethmoid. At birth this portion of the ethmoid is often divided into three or even four turbinated bones by grooves that disappear later in life. Beneath the turbinated bodies are three respective meati: the superior, middle, and inferior meati. The *inferior meatus* extends backward and downward, and at the junction of its anterior third with the posterior two-thirds receives

from beneath the inferior turbinated body the secretions of the eye through the nasal duct (Fig. 95). Its position upon the floor of the nose renders the inferior meatus the important drainage fossa of the nose, and along it the spray of an atomizer or the stream of a syringe should be directed if it is desired to wash secretions into the pharynx. Above the inferior turbinated body is the *middle meatus*, and because of the numerous ostea opening into it is an important fossa in nasal diseases. The superior turbinated body is a portion of the middle turbinate, separated from the rest of the middle turbinate by a groove, the *superior meatus*, closed in front but opening posteriorly into the spheno-ethmoidal recess.

The nasal cavities are divided into vestibular, respiratory, and olfactory regions, and the accessory cavities.

The *vestibular region* is all that portion of the nose anterior to the turbinated bodies. The *respiratory region* is the inferior nasal chambers posterior to the vestibular region, bounded above by the inferior edge of the middle turbinated body. Through this region of the nose the respiratory air-currents *arch* on their way to and from the pharynx. The *olfactory region* lies above the inferior edge of the middle turbinated body.

The **mucous** or **Schneiderian membrane** of the nose is a continuation of the external tegument, and is continuous with that of the pharynx, the Eustachian tubes, and the accessory sinuses. It is sometimes called the *pituitary* (meaning phlegm-producing) *membrane* or the *Schneiderian*, after Schneider, an anatomist, who first proved that the nasal secretions were produced by it and not by the brain. In many portions of the nose it is thin and inseparable as a membrane from the periosteum or perichondrium beneath, but over the inferior turbinate and the adjacent portion of the septum, as well as the inferior edge of the middle turbinate, it is thick and vascular. In these regions is the so-called *erectile tissue*, similar to that of the sexual organs, and consisting of cavernous blood-vessels imbedded in cellular tissue. When this tissue erects itself, that is, when its vessels fill with blood, the bulk of the nasal membrane enormously increases and may cause almost complete stenosis of the nasal chambers.

The vestibular mucous membrane is covered by stratified pavement epithelium and contains sweat and sebaceous glands, and anteriorly vibrissæ or short hairs that serve to prevent the entrance into the nostrils of coarse particles of dust and insects. The mucous membrane of the respiratory region is covered by pseudostratified ciliated epithelium and contains goblet-cells. Mucous, serous, and lymphatic glands are numerous. The mucous membrane of the olfactory region contains no erectile tissue and to it are distributed the specialized nerve-endings of the olfactory nerve. It is covered by a single layer of cylindric epithelium and

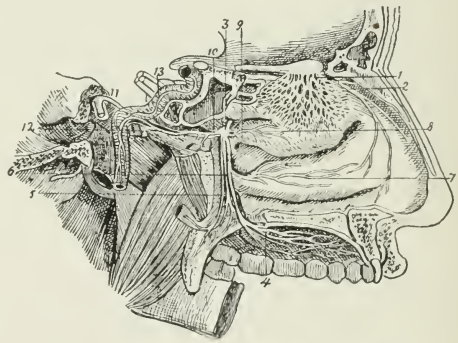


FIG. 52.—Nerves of nose and sphenopalatine ganglion, from inner side: 1, Network of external branches of olfactory nerve; 2, nasal nerve, giving its external branch to outer wall of nose; the septal branch is cut short; 3, sphenopalatine ganglion; 4, ramification of large palatine nerve; 5, small, and 6, external palatine nerve; 7, inferior nasal branch; 8, superior nasal branch; 9, nasopalatine nerve cut short; 10, Vidian nerve; 11, great superficial petrosal nerve; 12, great deep petrosal nerve; 13, the sympathetic nerves ascending on internal carotid artery.

contrasts by its yellow color with the bright pink of the parts below. In this thin pale membrane are the olfactory and sustentacular cells capable of receiving sensory impulses recognized as odors.

The **arteries of the nasal fossæ** are the anterior and posterior ethmoidal from the ophthalmic, the sphenopalatine branch of the internal maxillary, and the alveolar branch of the internal maxillary to the antrum.

The **nerves of the nasal fossæ** (Fig. 52) are the nasal branch of the ophthalmic to the septum and outer wall, anterior branch of the superior maxillary to the inferior turbinated

body, and the floor of the nose. The sphenopalatine ganglion gives off the Vidian nerve to the septum and superior turbinated body and the superior nasal branch to the same regions, the nasopalatine to the middle of the septum, and the anterior palatine to the middle and lower turbinates.

The olfactory or first cranial nerves from the olfactory bulb enter the nose through twelve or more openings on each side of the cribriform plate. They are distributed to the specialized nerve-endings in the mucous membrane of the olfactory region of the nose.

The **lymphatics of the nose** are numerous. The more anterior terminate in the submaxillary glands, the posterior communicate with the pharygneal glands.

PHYSIOLOGY AND PATHOLOGY OF MUCOUS MEMBRANES AND "CATCHING COLD"

During respiration the bulk of the air passes along the septum above the inferior turbinated body, describing a semicircle in its course, and extending upward nearly to the roof of the nose. Abnormal dryness of the nasal mucous membrane, or nasal obstructions of a kind to interfere with the free access of air to the olfactory portion of the nose, interfere greatly with the acuteness of the sense of smell.

Aitkin, experimenting with odorous substances, concludes that the sense of smell is excited not, as is generally asserted, by small particles of such substances resulting from their evaporation, but by gases.

The nose also serves as an additional resonant cavity during vocalization, so that obstruction of the nasal chambers invariably produces a peculiar nasal intonation during speech. Perhaps the most important function of the nose is to warm, moisten, and free from dust the inspired air. In health exhaled air invariably has a termperature of 98.5° F., and it has been proved experimentally that most of the heat supplied to inhaled air comes from the nose, the turbinated bodies being well adapted not only to warm the inspired air, but to moisten it and free it from particles of dust which adhere to its moist, sticky surface.

Dust particles removed from the skin of the face and

from the vibrissæ contain numerous bacteria from which cultures can be made. On the other hand, bacteria removed from the surface of the normal nasal mucous membrane evince little vitality and cultures are made from them with considerable difficulty. Hence it has been claimed that the nasal secretions possess sufficient antiseptic qualities to destroy some bacteria and inhibit the growth of others until they are removed from the nose by the use of the handkerchief. The practical point from this is that irritating antiseptic sprays before an operation are uncalled for, and by setting up what might be called a *chemic rhinitis* tend to promote the growth of bacteria rather than destroy them. This is particularly true of solutions of corrosive sublimate.

INFLAMMATION OF MUCOUS MEMBRANES

The most common forms are acute and chronic catarrhal inflammation, purulent, croupous, and diphtheritic inflammation.

In **acute catarrhal inflammation** an increased blood-supply stimulates the epithelial layer of the mucous membrane to increased activity ; new cells are rapidly formed and cast off, while the glands pour out their secretion in excessive quantities and an abundant liquor sanguinis transudes the vessels, the mucous membrane at the same time appearing red and swollen.

Chronic catarrhal inflammation differs from acute catarrhal inflammation in that the subepithelial layer of the mucous membrane is more involved. Connective tissue is developed by a slow process of proliferation. Usually the mucous membrane is thickened and hypertrophied ; but, in some instances, the new tissue may be so placed as to press upon the glands and follicles, giving rise to atrophy and the so-called atrophic or " dry " catarrh. Also in catarrhal inflammation of the mucous membrane there sometimes occurs increased activity in the lymphoid cells, finally producing hypertrophy of the tonsils or other adenoid structures. Activity of morbid processes, confined largely to epithelial and lymphoid structures, belongs essentially to the younger

period of life; while morbid activity in the connective-tissue structures belongs essentially to later life, rendering it much more difficult to bring about a cure in the catarrh of an adult than in that of a child.

Croupous inflammation is of a higher grade than catarrhal; for, while it commences in the same manner, with increased blood-supply, rapid cell-growth and proliferation, increased secretion, and a throwing off of immature cells, leukocytes, and liquor sanguinis, it differs from it in the fact that the exudate contains a large amount of fibrin and albumin, which coagulate upon the surface of the mucous membrane, forming a false membrane. This false membrane is at times so soft and almost granular in character as to be easily removed with a soft brush. At other times it is tougher and difficult of removal; but, in either case, when removed, the mucous membrane is left intact or only deprived of some superficial epithelial cells.

Diphtheritic inflammation is also characterized by the formation of a false membrane, but its pseudomembrane permeates the mucous membrane so densely that it can only be removed by bringing away with it the entire thickness of the mucous membrane to which it is attached, thus leaving the parts below completely denuded. A diphtheritic pseudomembrane is of a dark grayish color, resembling somewhat an ordinary slough of the mucous membrane, in contradistinction from a croupous membrane, which is of a bluish-pearl color, with no appearance as of sloughing of the parts.

Pathology.—In inflammation of mucous membranes the secretions are either increased or decreased in quantity, so as to either flood the parts or leave them unnaturally dry. It should be borne in mind that the normal secretion of the nasal mucous membrane is over 16 ounces of clear watery mucus in twenty-four hours, a part of which in health passes unnoticed through the nasopharynx down into the esophagus and stomach. Only when by obstruction or irritation, due to any cause whatever, this easy outflow and abundant secretion is interfered with do we perceive a thickening and an accumulation of the secretion of the mucous membrane, which is designated as mucus, and is composed

largely of epithelial cells in a state of fatty degeneration, mucous corpuscles, and the impurities filtered out from the inspired air. When mixed with pus or blood the secretions become yellow, green, or brown in color; and if retained upon the mucous membrane for a sufficient length of time the secretions become offensive as the result of putrefactive changes.

"**Catching cold**" is the result of a transient influence upon the vasomotor system of nerves, producing an uneven distribution of blood in the capillaries, especially manifesting itself as a congestion of the mucous membrane of the upper respiratory tract, followed in most instances by inflammation, swelling, and either diminished or excessive perverted secretion. It is probable that the phenomena of "catching cold" is largely of a reflex nature, in which the peripheral sensory nerve fibrillæ of the skin and extremities perceive the abstraction of heat as a shock, and being afferent in their conductive function, convey the impression to their respective ganglia, whence it is reflected by means of the efferent vasomotor fasciculi to the vessels, causing their dilatation and congestion, and, finally, inflammation of the structures containing them. This theory not only explains the ordinary phenomena of a "cold in the head," but also the pain of neuralgia and rheumatism suddenly produced by "catching cold." Dilatation of the vasonervorum, resulting perhaps in the effusion of serum, produces pressure upon a nerve within its sheath and consequent pain in the muscle or skin containing it.

The reason why the mucous membrane of the upper air-passages is the most frequent seat of an inflammation due to cold or a chilling of the surface of the body is that the sudden change of temperature produces, in the first place, an effect upon the sensory nerve-fibers in the skin, which impression is communicated to the vasomotor centers, and consequently results secondarily in a contraction of the blood-vessels of that portion of the skin which has been affected. As there is a certain amount of blood in the vascular system at a given time, a sudden contraction of any portion of that system must, according to the law of hydrostatics, cause a corresponding dilatation at some other portion,

which is that portion which is least able to resist the pressure. Inasmuch as our variable climate, the impurities of the atmosphere, and our artificial way of living have a tendency to weaken the capillaries of the upper air-passages from early childhood, that portion of the human economy is therefore the region most liable to suffer from this unequal distribution of blood. There results, first, engorgement of the parts with increased secretion and, finally, inflammation.

DISEASES OF THE NOSE

Effect of Disease of the Nasal Passages on Other Parts of the Body.—Nasal disease may extend to the pharynx, ear, or larynx by continuity of structure, or affect the other respiratory organs by abeyance of the functions of warming, moistening, and filtering the inspired air, so that it enters the pharynx cold, dry, and dust-laden, thus producing inflammation of the pharynx, larynx, and even of the parts below them. Chronic laryngitis frequently results from this cause; and while it is not easy to prove that pneumonic phthisis is directly the result of atrophic rhinitis, yet it is difficult not to suspect some such relationship between the two diseases. As the result of nasal disease there are often induced certain reflex phenomena, viz., nasal cough, nasal asthma, nasal vertigo, nasal epilepsy, nasal chorea, hay-fever, pareses of the palate and larynx, neuralgia and headache, reflex skin rashes, affections of the eye, both inflammatory and muscular, and diseases of the ear.

The term "reflex" is, doubtless, often misapplied, yet it has a definite significance, and the reflexes which originate in nasal or nasopharyngeal irritation and terminate in cough, laryngeal spasm, or asthma, follow much the same pathway as the reflex known as sneezing. The nasal branches of the ophthalmic division of the fifth nerve and the nasal branches of the anterior palatine descending from Meckel's ganglion, which is in connection with the superior maxillary division of the fifth nerve, conduct the sensory impressions to the medulla. It is there reflected to the respiratory, pneumogastric, and other centers, whence the deep inspiration, the

forced expiration, and the coincident spasm of the pharyngeal and laryngeal muscles, termed a sneeze.

Acute rhinitis is an acute catarrhal inflammation of the nasal mucous membrane.

The *synonyms* are coryza; cold in the head; acute nasal catarrh; in children, the snuffles.

Etiology.—It is generally the result of exposure to cold and wet when the body is overheated. It may, however, be produced by breathing hot dry air or inhaling irritating vapors and dust, errors of diet, or come on apparently as the result of a venereal debauch. Chronic catarrh, syphilis, rheumatism, dyspepsia, or a debilitated state of the system renders an individual more liable to attack. According to some authorities pathogenic micro-organisms play an important part in the production of a "cold in the head," and it has been claimed that the disease is infectious.

Pathology.—At first the mucous membrane, though swollen and congested, is dry. As the disease progresses, there is an abundant serous discharge, which becomes more and more charged with broken-down epithelial cells, lymph-corpuscles, pus-globules, etc., until the discharge assumes the character of a thick, tenacious mucus or mucopus. The deeper lying tissues also participate in the process. The erectile tissue becomes gorged with blood and swollen, in some instances completely occluding the nares.

Symptoms.—The onset may be simply an attack of sneezing, followed by increased and thickened discharges. In other cases the attack begins with chilly sensations and a general feeling of illness. There is a sensation of fulness and pain about the nose and forehead. The face may be flushed, the eyes suffused, and more or less fever be present. Sensations, almost suffocating in their character, may be present from occlusion of the nares, and the discharges be so irritating as to scald the skin of the alæ and upper lip. A cold in the head lasts from two or three days to as many weeks. It generally ends in complete resolution, but frequently repeated is a common source of chronic nasal catarrh. In nursing children the child takes nourishment only with difficulty, frequently pausing to breathe through the mouth.

Treatment.—A cold in the head can often be aborted at its commencement by a hot bath and a bowl of hot lemonade at bedtime, with or without 10 gr. of Dover's powder, followed in the morning by a saline purge and the wearing of extra warm clothing. The turgescence of the nasal mucous membranes and discharges can always be abated by the application of a 4 per cent. solution of cocain. This effect of the cocain can be kept up for several hours by spraying the interior of the nose with a 4 per cent. solution of antipyrin immediately after the application of the cocain solution. If repeated every day, this treatment gives great and immediate comfort to the patient and cuts short the course of the disease, while a soothing snuff (Formula 53) used by the patient in the intervals between the applications adds much to the efficiency of the treatment. In severe cases the patient had better remain in bed, and the presence of fever requires the administration of aconite in small doses at frequent intervals. Many pill makers manufacture what they term rhinitis tablets, the active ingredient of which is belladonna; $\frac{1}{120}$ gr. of this drug, taken every two hours for four or five doses or until a sensation of dryness in the throat is produced and then at much longer intervals, yields decided relief in controlling the nasal symptoms.

Simple chronic rhinitis is a catarrhal inflammation of the nasal mucous membrane, exhibiting but a slight tendency to spontaneous recovery.

The *synonyms* are chronic catarrh; subacute rhinitis; chronic cold; chronic coryza; rhinorrhea.

Etiology.—It is generally the result of uncured rhinitis or frequent attacks of coryza.

Pathology.—The mucous membrane of the nose presents precisely the appearance seen in acute rhinitis, only it is less swollen and less red in color. The discharge is either watery, if the upper parts of the nose, especially the mucous membrane of the middle tubinated bodies, are the parts most affected; or it approaches mucopus in character if the disease is mostly located in the lower parts of the nose.

The *symptoms* are precisely those of acute rhinitis, only less pronounced. There is a feeling of fulness about the

nose, a continual discharge, and the sufferer is continually "catching cold," when, of course, all his symptoms are increased in severity.

Prognosis.—Untreated, chronic rhinitis may continue indefinitely, and finally result in hypertrophic rhinitis, the pharynx also gradually becoming affected. Treated in the following manner a cure is frequently brought about in from three to six weeks.

Treatment.—Ordinarily the tone of the system is below par and a tonic is indicated. In such cases Formula 85 answers a most useful purpose. If the bowels are sluggish, it is advisable to direct the occasional use of a saline cathartic. *Cleanliness* of the mucous membrane is of primary importance, and may be secured by the patient using at home, twice a day, a bland alkaline antiseptic wash (Formulas 1 to 10) with an atomizer.

The application of an alterative or an astringent to the nasal mucous membrane in these cases is of the greatest value, and the following formula has long been popular for this purpose:

℞	Iodini,	gr. v;
	Potassii iodidi,	gr. xv;
	Glycerinæ,	f ℥j.—M.

The result of the application of this formula varies according to the amount of the solution used. When the nose is extremely sensitive only a small amount of cotton should be wrapped about the applicator, so as to form a brush capable of absorbing but a small amount of the solution, which should be carefully applied to those portions of the nasal mucous membrane where the inflammation seems greatest; the cotton brush should also be passed along the floor of the nose and the application painted upon the pharyngeal mucous membrane. After the application of the iodin solution the use of some protective upon the nasal mucous membrane is advisable. This indication may be secured by means of a spray of fluid albolene, applied until the mucous membrane of the nose and nasopharynx is thoroughly coated with it. The albolene serves the purpose also of "spreading" the application previously made,

which, to all intents and purposes, becomes, after the use of the cosmolin, an ointment thoroughly coating the Schneiderian membrane.

Instead of plain albolene, what is frequently referred to as menthol-camphor-albolene may be employed. The formula is:

℞ Menthol, gr. v;
Camphor, gr. xx;
Albolene, f ℥ij.—M.

In certain cases either of the following formulas when applied to the nose give quicker and better results than the iodin solution, especially in adults:

℞ Boroglycerid, 50 per cent.

℞ Acidi tannici, gr. xl;
Glycerinæ, f ℥j.—M.

A case of simple chronic rhinitis is then perhaps best treated in the following manner: The patient is ordered a tonic, instructed to wash out his nose night and morning with either Dobell's solution or one of its modifications described above, and to present himself at the physician's office at least twice a week, but better every other day, for treatment. After first cleansing the nose with a spray from an atomizer filled with either alkaline solution, the physician should make an application of the iodin solution and follow it with a spray of menthol-camphor-albolene.

Purulent rhinitis is an inflammation of the Schneiderian membrane in which the discharge from the beginning is purulent. It is usually chronic in character and more common in children.

Etiology.—It probably always results from specific infection of some kind. It may occur during the course of one of the exanthemata, diphtheria, etc. Some cases occurring in young infants appear to be due to gonorrheal infection from the vagina during birth.

Pathology.—The bacteria characteristic of the infection are found in the discharges or in the mucous membrane. Pseudomembrane usually occurs from the presence of

the Klebs-Löffler bacilli or some of the other bacteria. Primary nasal diphtheria without systemic involvement, or at least systemic symptoms sufficiently severe to confine the patient to bed, is not a very uncommon disease. Under such circumstances the most noticeable symptom is complete occlusion of the nares by the swollen mucous membrane and pseudomembrane, a culture from which yields the characteristic bacillus of diphtheria. When the bacteria of purulent rhinitis are sufficiently virulent to cause actual destruction of tissue, deep ulcers occur, with final formation of scar-tissue. The disease in childhood is probably the most common cause of atrophic rhinitis in after life. Some cases are the result of inherited syphilis.

Symptoms.—The disease is most common in children and is characterized by a fetid, thin, purulent discharge, sometimes streaked with blood, which often excoriates the lip and alæ of the nose. The nasal mucous membrane is red, swollen, and ulcerated, and may or may not be partly covered by a pseudomembrane. An infant is often able to nurse only with considerable difficulty, and hence such infants are frequently emaciated. An improvement in the infant's condition consequently results as soon as the disease subsides sufficiently to permit nasal breathing.

Treatment.—The nasal mucous membrane should be cleansed at least twice a day with an alkaline spray.

In infants the nose is more effectively cleansed by means of a syringe than by the spray from an atomizer, and the bulb rubber ear syringe (Fig. 48) is probably most useful for this purpose. Extreme gentleness should be used in syringing, in order to prevent fluid entering the middle ear. In children who have not yet learned to blow their nose, it is best to blow it for them by inserting the syringe tip into one nostril and forcibly compressing the syringe-bulb. By this means a current of air is forced into one nostril and out of the other, blowing the mucus and pus before it. After the nose has been cleansed of the major portion of the secretion, Dobell's solution may be dropped in by means of the syringe. A small quantity of gallic acid ointment, from 3 to 10 gr. to 1 ounce of vaselin, according to the age of the child, should then be placed within

the nostrils with a brush. This home treatment should be carried out twice a day.

The physician himself should treat the child two or three times a week or oftener by cleansing the nasal mucous membrane as described above, using an air-douche either from a syringe or, in the case of larger children, the Politzer bag to blow mucus from the nose both before and after the use of the atomizer. When thoroughly cleansed the nose should be sprayed with albolene and dusted with powdered calomel or aristol by means of a powder-blower, care being taken that none of the powder reaches the pharynx and is swallowed.

In scrofulous children hygienic measures are often as important as local treatment. Cod-liver oil and syrup of the iodid of iron will be required in many instances. In primary nasal diphtheria with pseudomembranes, these should be removed with forceps and peroxid of hydrogen, and the underlying mucous membrane painted with a 60-gr. solution of nitrate of silver. The nasal mucous membrane should then be sprayed with menthol-camphor-albolene, and the parts covered with calomel or some other reliable antiseptic powder.

In many cases of pseudomembranous rhinitis, where the Klebs-Löffler bacillus is present, there is an entire absence of constitutional symptoms, and it often requires some persuasion to induce the parents to keep the child away from school. However, quarantine, at least to the extent of avoiding contact with other children, should be insisted upon. At home the nasal mucous membrane should be sprayed every two to four hours with 3 per cent. peroxid of hydrogen diluted with an equal quantity of Dobell's solution, and then with menthol-camphor-albolene.

Hypertrophic rhinitis is a chronic inflammation and hypertrophy of the nasal mucous membrane and submucous tissues with hyperemia or permanent dilatation of the blood-vessels. Hypertrophy of an organ is due to an increase in the size of the cells, while hyperplasia is an increase in the number of cells. Both conditions imply an increase in the bulk of an organ. In the turbinated bodies of the nose the conditions can be differentiated from the fact that in hypertrophy

the parts are soft to the touch and shrink greatly under the application of cocain or adrenalin, while in hyperplasia the parts are firm to the touch and do not shrink greatly under cocain.

The *synonyms* are obstructive rhinitis; hypertrophic nasal catarrh.

Etiology.—It is invariably the result of long-continued simple chronic rhinitis or frequent attacks of coryza. It is said to occur most readily in the gouty and rheumatic.

Pathology.—While in long-continued simple chronic rhinitis there is already some thickening of the epithelial layer of the mucous membrane, yet the disease only becomes hypertrophic rhinitis when the thickening involves the other elements of the mucous membrane and the submucous structures. As the result of frequent attacks of inflammation the blood-vessels become permanently dilated and their walls thickened, glandular tissue is hypertrophied, infiltrations occur, which finally become organized into connective tissue, so that the thickened turbinated tissues cannot collapse as when normal, and remain permanently distended with blood. This thickening is most noticeable at the anterior and posterior parts of the middle turbinated bodies, where it is called an anterior or posterior hypertrophy. Generally as the result of traumatism, ecchondroses and exostoses occur upon the septum opposite the pendulous portion of the inferior turbinated bodies, thus increasing the nasal obstruction. Often a "bank" or "ridge" of cartilage and bone will extend for a long distance along the septum opposite the inferior turbinated body, or along the sutures of the cartilaginous and bony septum.

Symptoms.—The most prominent symptoms are those of nasal obstruction, want of proper drainage from the nasal cavities, and increased secretions. When the obstruction is great and constant the patient becomes a "mouth-breather." The inspired air, under such circumstances, not being properly warmed, moistened, and freed from dust in its passage through the mouth, causes dry lips, a coated tongue, follicular pharyngitis, and sometimes chronic laryngitis. When the nasal occlusion is complete, the face

assumes a stupid expression on account of the constantly open mouth. Should the habit of mouth-breathing be acquired in early childhood and continued for some years, even the shape of the bones of the face is altered and the habit of mouth-breathing retained long after the nasal obstruction has disappeared. In most cases of hypertrophic rhinitis any position favoring the gravitation of blood into the hypertrophied parts is sufficient to cause their distention; hence, when the patient is in bed, first one nostril and then the other will become occluded, according to which side of the body is lain upon. This is especially true

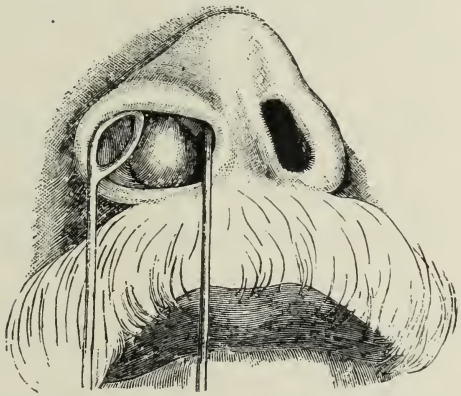


FIG. 53.—Nostril dilated by Bosworth's speculum, showing anterior hypertrophy (Seiler).

when large posterior hypertrophies are present. Obstruction and suppuration of the nasal duct not infrequently occurs as the result of inflammation of the duct, beginning at its nasal orifice. An anterior hypertrophy of the middle turbinated body pressing on the septal nerve, which is a branch of the ophthalmic, frequently causes reflex eye-symptoms, such as chronic conjunctivitis, slight paresis of accommodation, and irritable retina. The olfactory slit may become closed from hypertrophy of the middle turbinated body, and thus interfere with the sense of smell and also that of taste to a corresponding degree. Redness of the tip of the nose and acne are also apparently in some cases the result of interference with the blood

supply of the skin. Hearing may be gravely compromised from the pressure of hypertrophies interfering with the blood supply of the Eustachian tubes, the damming up of their secretions, or the extension of the disease to their lining mucous membrane. Headaches are often complained of, and a feeling of pressure or even of pain at the root of the nose, as the result of occlusion of the infundibulum.

The patient frequently complains that he has "a bad breath." In many cases the offensive odor is due to decaying epithelium upon the tongue as the result of mouth-breathing or dyspepsia. At other times the "bad breath" of which the patient complains is perceptible only to himself, and is probably due to irritation of the olfactory region of the nose, contrasting strongly in this respect with atrophic rhinitis. If any "catarrhal odor" of the breath of

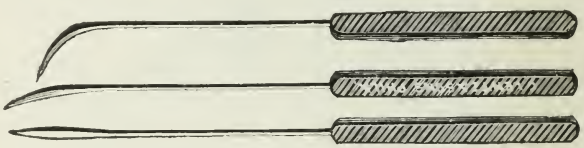


FIG. 54.—Jarvis' transfixing needles.

an individual with hypertrophic rhinitis be present, it is always more annoying to himself than to a bystander.

Treatment.—Each case should be treated as one of simple chronic rhinitis until the inflammation of the Schneiderian membrane has disappeared, when operations should be undertaken for the removal of any tissue causing obstruction.

Removal of Anterior Hypertrophies.—If large, especially if the hypertrophy consists of hyperplastic tissue, that is, tissue that does not contract when cocain is applied, the operation with Jarvis' needles and snare (Figs. 54 and 55) will be found most satisfactory. The base of the hypertrophy should be transfixed with a needle and the wire loop of the snare so placed that it surrounds the base of the hypertrophy beneath the needle. The loop being drawn tight, the milled nut of the instrument is turned slowly until the wire loop has cut through the tissues. If the operation is done slowly little or no hemorrhage results. Anterior

hypertrophies of the middle turbinated body may, however, be removed in the same manner without the use of a needle. Small anterior hypertrophies can be removed very satisfactorily by simply cutting through them with a sharp knife to the bone. This method is of advantage in children, where, as the result of eczema of the lip and alæ, and great inflammatory swelling of the skin and mucous membrane, it is difficult to do any other operation. If cocain be used, the cutting causes no pain, and may be repeated as often as the cut heals, until the eczema and hypertrophy have disappeared, which often occurs within a few weeks.

FIG. 55.—Jarvis' snare.

Anterior hypertrophies may also be destroyed by means of chemic *caustics*. These applications are, however, so unsatisfactory, in comparison with other measures at our disposal, that it is best not to employ them unless nothing better is obtainable at the time of the operation.

Perhaps the best method of removing anterior hypertrophies is by the *galvanocautery*. A pledget of absorbent cotton, saturated with a 3 per cent. solution of cocain, is introduced into the inferior meatus and allowed to remain in contact with the hypertrophy until it has shrunken as much as possible and the parts are thoroughly anesthetized. A metal speculum is introduced after the removal of the cotton and the hypertrophy exposed. After the platinum wire of the cautery-knife is at a dull-red heat it is placed upon the thickest part of the hypertrophy, and by means of gentle to-and-fro movements is made to cut through to the bone, when it is carefully withdrawn, so as not to detach the eschar which it has formed. The operator should be careful to cut down to the periosteum before withdrawing his cautery-knife or the results of the operation will be far from satisfactory; for, although

a superficial burn either with the galvanocautery or chromic acid heals very quickly and gives a certain amount of relief for a short time, yet the results are not as permanent as when the cautery-knife is made to penetrate the periosteum.

No after-treatment is required beyond keeping the wound as dry as possible and endeavoring to avoid detaching the eschar before the healing process has been completed beneath it. Should, however, the eschar become detached an antiseptic and astringent powder may be applied with advantage to the wound to form an artificial scab. The day following the operation there may be some inflammatory reaction and the nostril occluded by swelling of the wounded hypertrophy, the patient feeling as if he had caught cold in that nostril; but this quickly subsides *if all catarrhal inflammation has been removed before the operation was undertaken.* When this has not been done, slight elevation of temperature and inflammation of the tonsil and perhaps other lymphatics on the same side as the operated nostril sometimes occur, and indicate the presence of a mild infection.

Although nearly six weeks are sometimes required for the complete healing of a cautery wound, yet little inconvenience is usually experienced by the patient during the healing process, except that during the first week the nostril is sometimes more obstructed than ever as the result of swelling. At the end of about ten days the slough produced by the burning separates from the wound and decided advantage from the cauterization is then first experienced. The improved respiration becomes greater and greater until the wound is finally entirely healed. The anterior portion of the turbinate then presents a somewhat pale appearance, with a depression indicating the seat of the cautery application. The turbinate not only is diminished in size, but sudden change in its volume, with consequent obstruction of the nostril, is also prevented. The patient states he "does not 'catch cold' as readily as before the operation."

The cautery should be used judiciously, as great and permanent injury may result from the work of a careless or brutal operator. Large tracts of mucous membrane may be destroyed by application of the flat side of the cautery-

knife or the spreading over a moist mucous surface of a chemic caustic. Such wounds heal slowly and some time elapses before the scar becomes covered by an epithelium that functionates properly.

The galvanocautery should be used cautiously upon the middle turbinated bone, only a very small knife being employed for the purpose. Its application to the posterior

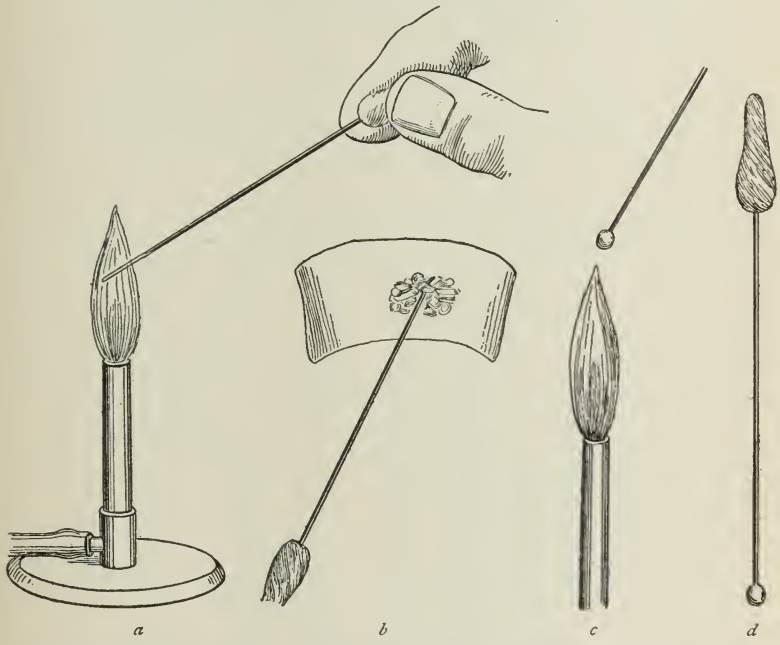


FIG. 56.—Fusing chromic acid on an Allen's probe: *a*, Heating probe to redness; *b*, catching up a crystal; *c*, heating to round into a bead; *d*, finished probe.

portion of the nose is best avoided. Because of the thinness of the cartilaginous septum and the low vitality of its cartilage deep cautery wounds generally result in a perforation. Because of the edema that sometimes results the cautery should not be used on the uvula, the anterior pillars of the fauces, the arytenoids, or the glosso-epiglottic folds except with extreme caution. It is permissible to remove a little mass of mycosis by means of the galvanocautery from

these regions, but a very small cautery-knife should be employed and the burn should be very superficial.

Chromic acid is more frequently employed than any other chemic caustic in the treatment of anterior hypertrophies. It should be used in the following manner: The end of an Allen's probe (Fig. 56) is heated and plunged into a bottle containing crystals of chromic acid, some of which will adhere to the probe and be withdrawn with it from the bottle. A further application of heat will fuse these crystals upon the probe, which is now ready for use. The probe may also be prepared for use as a cautery by wrapping a few fibers of absorbent cotton about its end and rubbing into it moist powdered crystals of chromic acid until the cotton is saturated with the paste.

The parts having been cocainized, the end of the probe covered with chromic acid is pressed firmly into the hypertrophy and pushed backward and forward over the line to be cauterized, and finally withdrawn. After the lapse of a few moments the nasal chamber is thoroughly washed with the spray from an atomizer containing an alkaline solution, care being taken that none of the resulting chromic salt reaches the pharynx and is swallowed, as it is poisonous.

Chromic acid is more uncertain in its action than the galvanocautery-knife, and the same is true of *trichloracetic acid*, which is used in practically the same manner, except that, being a liquid, it cannot be fused on to the end of a probe.

Cautery Batteries.—Any galvanocautery battery that is capable of heating the platinum wire of the cautery-knife to a cherry-red heat will answer, but a good storage-battery is cheaper and cleaner and less liable to get out of order than most primary cautery batteries. Portable storage-batteries can be obtained and may be charged from the wires of an electric light company or from four or five cells of the ordinary sulphate-of-copper battery used in telegraphy. For office use, one cell of a Flemming portable storage-battery and four Watson sulphate-of-copper cells to charge it with electricity will be found an efficient and cleanly outfit. However, such an outfit will hardly be sufficient for all purposes. Each cell of a storage-battery supplies $2\frac{2}{10}$ volts of tension, the quantity of electricity

furnished being expressed in ampère hours. A cell furnishing fifty ampère hours will supply fifty ampères for one hour or one ampère for fifty hours. Other things being equal, the number of ampère hours depends upon the size of the cell; but the voltage or pressure of the current

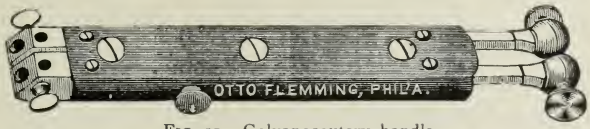


FIG. 57.—Galvanocautery handle.

depends solely upon the number of cells, each cell supplying only $2\frac{2}{10}$ volts, regardless of its size. It requires for each cell four or five sulphate-of-copper cells to charge it efficiently.

Electric motors are supplied that do efficient work with a 2-volt current, and for such motors, galvanocautery-knives, and snares one large storage-cell is sufficient.

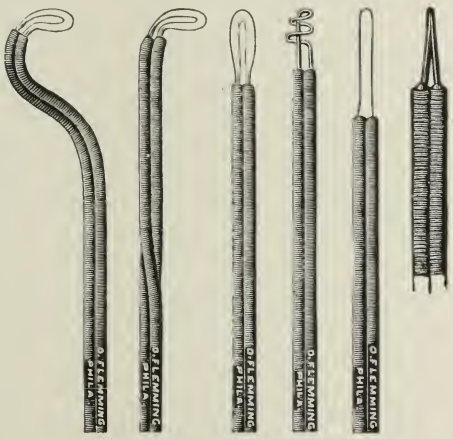


FIG. 58.—Cautery-knives.

A very satisfactory electric outfit for heating cautery-knives can be constructed from ordinary dry cells such as can be obtained in any electric supply store for about 30 cents a piece. For the larger knives it is safer to have as

many as twelve cells; for the smaller knives, three or, at most, six cells will be sufficient. The cells then should be arranged in a box in series of three and multiples of two and four. (Fig. 59 shows the arrangement of cells and binding posts.) When the cautery-knife is connected with binding posts 1 and 2 but two series of three cells are in the circuit and there is little danger of melting the thin platinum of a small knife. When binding posts 1 and 3 are used, four series of three cells will be in the circuit and sufficient electricity will be furnished to heat the largest knives. The advantage of this arrangement is that when the cells become exhausted others readily can be purchased in any electric supply store. This arrangement of the cells cannot be used for small incandescent lamps for purposes of transillumination, as the voltage of such lamps is commonly greater than that furnished by three cells in series. In fact, for purposes of transillumination, it is convenient to have six cells in series.

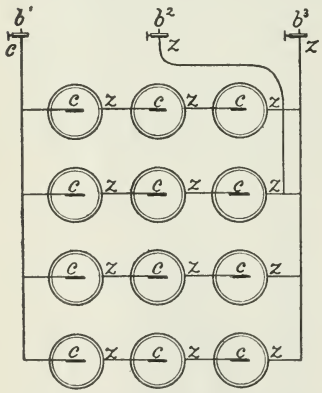


FIG. 59.—Diagram showing arrangement of ordinary commercial dry cells for cautery: b^1, b^2, b^3, Binding posts; *c*, carbon; *z*, zinc.

When the rhinologist's office is lighted from the wires of an electric supply station some form of "converter" may be used to secure a current suitable for the galvanocautery, snare, miniature lamps, and electric motor. Apparatus also may be purchased for obtaining from the companies' wires both a suitable galvanic and faradic current for medicinal purposes.

Removal of Posterior Hypertrophies.—A Jarvis snare should be threaded with No. 5 imported steel piano wire, as the wire should have sufficient resistance not to bend away from the base of the hypertrophy after it has engaged the growth. The loop of wire should be bent to one side before being introduced into the nostril, so that it may the more readily be passed around the hypertrophy and remain

in position when the loop is tightened. Being made as small as possible without distorting it by pulling down the sliding tube upon the handle of the instrument, the loop is carefully introduced along the floor of the nose until the posterior wall of the pharynx is reached, when the loop is again enlarged by pushing upward the sliding tube, and the instrument at the same time is slowly withdrawn as its handle is carried toward the septum. By this means the wire is made to surround the hypertrophy and a resistance is finally felt as the instrument is withdrawn, caused by the bight of the loop coming in contact with the base of the hypertrophy. The wire loop is now quickly tightened around the hypertrophy by pushing forward the instrument within the sliding tube, and the milled nut is quickly screwed downward into place. Two or three additional turns are given to the milled nut to be certain that the wire is tight about the base of the growth and that the instrument is held firmly in place without danger of slipping, when the patient may be allowed to rest. The sudden tightening of the wire loop occasions the patient some pain, which, however, soon subsides, when the loop may be still further tightened by turning the milled nut until the patient begins to again experience pain. In this way, proceeding slowly and carefully, the hypertrophy is finally squeezed off from its attachment, and is generally removed clinging to the end of the instrument by some fibers that have been drawn down into it with the wire. Should, however, the growth not be removed with the instrument, no attempt should be made to dislodge it from the nose, as it forms an efficient plug to prevent hemorrhage, and will probably drop into the fauces and be expectorated within twenty-four hours after the operation. From thirty minutes to two hours should be thus consumed in removing a posterior hypertrophy in order to prevent severe hemorrhage, which, from its situation, might be difficult to control; the patient should sit a while in the doctor's office before proceeding homeward, and should be cautioned against walking rapidly, violently blowing his nose, or hawking and spitting. Ordinarily there is very little blood lost at the time of the operation, but for some days afterward the patient expectorates a

blood-tinged mucus. Owing to the compression of the wire, the wound made by snaring a posterior hypertrophy is but small and generally heals rapidly. Where there are several posterior hypertrophies present in the nose, a second operation may be done a week after the first. If a posterior hypertrophy is very small and sessile it may more easily be removed if the operator waits until his patient has caught cold, when the swollen growth is more readily grasped with the wire. Cocain should not be used as a local anesthetic for the removal of posterior hypertrophies because it shrinks the tissues to such an extent that it is difficult to grasp the hypertropy with the snare. A 10 per cent. solution of stovain does not contract the tissues and hence is the preferable anesthetic for this operation.

Ecchondroses and Exostoses of the Septum.—A localized cartilaginous thickening or projection from the cartilaginous septum is called an ecchondrosis, while a similar bony growth upon the bony septum is referred to as an exostosis or hyperplastic osteoma. Heteroplastic osteoma is a name given to rather a rare form of bony nasal growth which springs from the cellular tissue beneath the mucous membrane, is not continuous with the cartilaginous or bony framework of the nose, and is therefore movable. Frequently ridges or shelves of cartilage and bone are found extending along the septum nearly from the anterior to the posterior nares. Usually such growths are opposite the lower turbinated body or follow the suture between the vomer and superior maxillary or that between the triangular cartilage and the vomer.

Etiology.—They are doubtless sometimes merely provisional callus that has escaped absorption and been deposited upon an old fracture of the septum. The fracture may have been received during early childhood as the result of one of the numerous "bumps upon the nose" that children are constantly receiving.

Symptoms.—Frequent nasal obstruction. Atrophy of the turbinated body opposite them is not uncommon, nor neuralgia of the whole side of the face as the result of intranasal pressure. Sometimes the crest of such growths is ulcerated, and a thin, irritating, sanious discharge results,

impossible to cure except by the removal of the exostosis or ecchondrosis. The nostril being obstructed in front, the breath current is interfered with in such a way that there is a constant rarefaction of the air at the orifice of the Eustachian tube at each inspiration, and as the result of "vacuum congestion" tinnitus and, finally, otitis media and deafness result.

Operations.—Localized thickenings of the cartilaginous septum may be cut through and removed by means of a small probe-pointed tenotome. When the growth is hard and bony it is best removed by means of a chisel or saw. It should be borne in mind that only that portion of the growth should be removed which interferes with proper nasal respiration. This, of course, means in most instances the whole of the growth. In a roomy nostril, however, and in atrophic rhinitis the growth may in some instances be doing good by occupying a certain amount of space in a nostril already too large, and under such circumstances its removal would probably cause postnasal catarrh and chronic pharyngitis. The patient is prepared for operation by placing a piece of absorbent cotton saturated with a 4 per cent. solution of cocain within the nostril. The cocain should be allowed to remain in contact with the structures to be operated on for at least twenty minutes that its anesthetic effects may penetrate as deeply as possible. After the removal of the cotton the nostril should be sprayed with a 1 : 1000 solution of adrenalin to render the operation as bloodless as possible. The line of incision should then be painted with a 10 per cent. solution of cocain.

The parts to be operated upon should be exposed by means of the author's dilator (Fig. 21), which will be found very convenient for operations within the nose, because when once in position it is more nearly self retaining than any other nasal speculum, and is not easily displaced by the struggles of the patient during an operation. If a chisel is to be used the patient's head is made to rest against a firm support, and the edge of the chisel is placed against the anterior portion of the exostosis and made to penetrate as deeply as possible by pushing it forward with the hand. If necessary the operation is continued by hammering upon

the handle of the chisel with a lead mallet until the growth is felt to be severed from its attachment to the septum. Ordinarily, after the use of the chisel, a few sherds of mucous membrane still bind the growth to the septum. These are severed by passing the wire loop of a snare around the growth, and the exostosis withdrawn from the nostril by means of the snare or forceps. The advantage of the chisel operation is the quickness with which it can be performed; but after the first cut has been made the nostril is deluged with blood and the operator has to complete the operation entirely by the sense of touch, being careful to hold his chisel, while hammering upon it, with its blade exactly parallel to the septum.

The operation is brutal and is almost invariably followed by syncope, as the result, perhaps, of the concussion of the brain caused by the blows of the mallet. When the exostosis is large the results are frequently unsatisfactory, a large jagged wound generally resulting from frequent applications of the chisel. The operation, if justifiable at all, is only so in cases where the exostosis is attached to the septum by so narrow a base that it may be severed by a single thrust, as it were, of the chisel or gouge.

When the saw is used, it should be entered *below* the growth and the sawing done in an upward direction, so as to obscure the field of operation as little as possible by blood, which, of course, flows downward from the wound. When the shelf of bone is large and hard the operation is necessarily tedious; but at any stage of the operation the saw may be withdrawn and both operator and patient rest, a plug of absorbent cotton saturated with a 4 per cent. solution of cocain being again inserted within the nostril. Under these circumstances the cocain acts as a hemostatic, and the probability is that the nostril will be found free from blood when the cotton is withdrawn, so that the operator can readily see to replace the saw in the cut already made. However, if necessary the nose may be sprayed with a 1 : 1000 solution of adrenalin from time to time during the operation. It is possible in some instances to secure a practically bloodless operation; but it should be borne in mind that adrenalin contracts only the more superficial vessels, and

that if a large vessel is severed, especially one deeply imbedded in bone, the hemorrhage may be severe. Under such circumstances the operation should be completed as speedily as possible and the severed mass of bone removed. The nostril should then be quickly "packed" with cones of absorbent cotton saturated with peroxid of hydrogen, as described in the section on Nasal Hemorrhage. It is well before undertaking any operation to have several cones of cotton prepared so as to be able to quickly control hemorrhage should it occur.

There are many varieties of *nasal saws* for sale in the instrument stores. That of Sajous (Fig. 60, *a*), Bucklin (Fig.

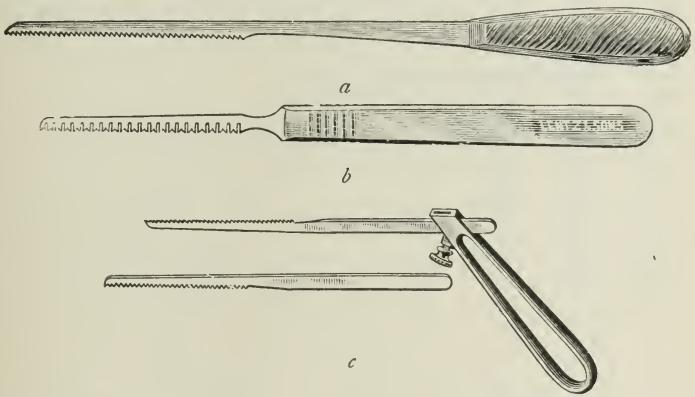


FIG. 60.—Nasal saws: *a*, Sajous' saw; *b*, Bosworth's saw; *c*, Bucklin's reversible saw.

60, *c*), with teeth arranged like a metacarpal saw, sever the bone more rapidly than the others, and hence are to be preferred when the mass of bone to be removed is large and hard. Sajous' saw is the more rapid of the two.

Not infrequently, after the bone has been completely severed, it will be found difficult to cut with the saw the shreds of mucous membrane by which it is still attached to the septum. These shreds usually can be easily cut with the nasal scissors. However, in most instances the snare (Fig. 54) is by far the preferable instrument. The snare is especially useful in cases where a small exostosis has apparently been completely severed, but has disappeared from

view in the blood within the nose. In some of these cases it is difficult to locate and grasp the mass with forceps, and impossible for the patient to blow it from the nostril because of a shred or two of uncut mucous membrane; under these circumstances if the wire loop of a snare is passed beyond the position of the exostosis and then kept closely in contact with the septum as it is withdrawn from the nose, the loop will hardly fail to encircle any shreds that still connect the exostosis to the septum, and after these are severed by closing the loop the exostosis usually is withdrawn from the nose with the snare by means of fibers that have been drawn into the tube of the snare.

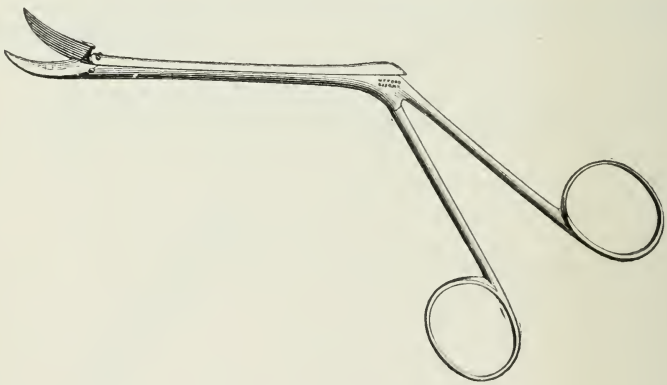


FIG. 61.—Nasal scissors.

Drills.—The motive power for the drill is supplied through a flexible armpiece (such as is used by dentists) by a small electromotor suspended from a movable bracket attached to the wall, at one side of the patient's head. Many of the drills and trephines offered for sale are rendered so clumsy by the shield designed to protect the parts about the field of operation from injury that the trephine and shield cannot be introduced more than $\frac{1}{2}$ inch within the nostril without hiding everything from view; while the instrument is too short to reach from the anterior to the posterior border of the septum (Fig. 62). There is, moreover, so much rattling of the trephine inside the shield as to interfere

materially with the delicacy of the sense of touch through it. These faults are overcome by lengthening the shanks of trephines and burrs, and constructing the shield as shown in Fig. 63. So modified, the trephine seems to possess all the advantages of both chisel and saw for the removal of bony growths from the septum, and none of the disadvantages of either instrument.

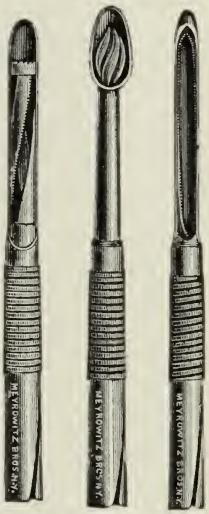


Fig. 62.—Electric-motor drills.

The operation with the drill is performed in the following manner: A trephine sufficiently large to remove at once the major portion of the exostosis is selected, and with its shield is adjusted to the armpiece of the electric motor in such a manner that the shield will protect all parts of the nose from injury except those to be cut away. The teeth of the trephine are now pressed into the anterior part of the growth, and as the instrument is pushed forward a piece of bone is cut from the exostosis, which enters the cavity of the trephine, where a knife set at an angle cuts it into pieces sufficiently small to pass through a fenestra made for this purpose. Should a sufficient amount of the growth not be removed by the first passage of the trephine through the nasal fossa, the trephine may be reapplied as often as may be necessary to

Fig. 63.—Gleason's electric-motor drill.

remove the entire exostosis and leave a smooth, flat surface like that made by a saw.

When an ecchondrosis or exostosis has attached itself to the inferior turbinated bone, so that a synechia or "bridge" extends from the septum to the opposite side of the nostril, it is perhaps best removed by first sawing

through the portion next the septum, then snaring the attachment to the turbinate. Unfortunately, after such an operation the "bridge" is very liable to recur, owing to the granulations from the cut surfaces of each side of the nostril approaching each other during the healing process until they finally unite. To prevent this disaster, a steel probe may be used to break down the adhesions, or a piece of tin-foil or gutta-percha may be worn inside the nose between the cut surfaces until the healing process is complete. Ordinarily nasal operations, either with saw or chisel, require no after-treatment beside the free use of an alkaline wash by the patient, in order to keep the wound clean. There is but little inflammatory reaction and the wounds heal promptly.

Packing the nose with iodofom gauze or any other substance after a nasal operation should be avoided if possible. It is only permissible to check hemorrhage or when the patient has to travel a considerable distance after leaving the surgeon's office before reaching home. Under such circumstances a narrow strip of iodoform gauze, previously saturated with fluid albolene, should be placed in the nose in such a manner as to make gentle pressure upon the wound. Such a packing can generally be removed in from twelve to twenty-four hours, if care is taken to remove it gradually, so as not to remove the pressure from the wound too suddenly.

When no dressing is used, which is by far the preferable method, blood-stained mucus is blown from the nose for some days after the operation.

Turbinectomy, or removal of the whole or, at least, the greater portion of the inferior turbinated body, has been performed to secure increased breathing space, for the removal of malignant growths, and for other reasons.

Turbinotomy, or the removal of a portion of the inferior turbinate, has been already described. The removal of a portion of the middle turbinate will be considered in the section on Ethmoiditis. Practically, turbinectomy of the middle turbinate is never performed.

When sufficient nasal respiratim can be secured by operations on the septum, such as the removal of an

exostosis or bringing a septal deviation into the median line, it is better not to remove any large portion of the inferior turbinated body because of the great destruction of mucous membrane and erectile tissue.

Moreover, a turbinectomy done to relieve the stenosis caused by a deviated septum would accomplish nothing toward improving the condition of the wider nostril. As a matter of fact, when middle-ear catarrh results from deviation of the nasal septum, it frequently begins in the ear of the same side as the wider naris.

The operation is done in the following manner: The nasal mucous membrane is cleansed with spray from an atomizer containing Dobell's solution or some other suitable alkaline fluid. The nasal mucous membrane is then sprayed with a 1 : 1000 solution of adrenalin in order to prevent hemorrhage. The upper and lower portion of the attachment of the inferior turbinate is now cocainized with a 4 per cent. solution of cocain. All adhesions between the turbinate and the septum are broken down and the saw inserted just beneath the articulation of the turbinate with the maxillary bone. The sawing is done diagonally upward and inward until the articulation is severed. Should the saw fail to sever some shred of connective tissue and mucosa that still unite the turbinate with the superior maxilla, these are cut with a pair of scissors and the turbinate grasped with a pair of forceps and removed from the nose.

Should hemorrhage render such a procedure necessary, the nostril is packed with iodofom gauze saturated with peroxid of hydrogen and the patient placed in bed. This packing is removed permanently after twenty-four hours unless renewed hemorrhage necessitates replacing the packing. During the period required for the healing of the wound the nose is cleansed with Dobell's solution and the wound covered with a powder consisting of equal parts of aristol and stearate of zinc.

Atrophic rhinitis is an atrophic condition of the nasal mucous membrane, usually also of the submucous tissues; and occasionally of the turbinated bones and septum. The disease is characterized by a lessening in the size and thick-

ness of the intranasal anatomy, a change in the color of the mucous membrane, and partial loss of function as the result of a decrease in the number of component cells, hence the formation of crusts of inspissated and putrid mucus which emit a fetid and offensive odor.

The *synonyms* are dry catarrh; atrophic nasal catarrh; in children, scrofulous rhinitis; and where there is a stench, ozena.

Etiology.—Atrophic rhinitis is said to result from long-continued hypertrophic rhinitis. An abnormal dryness of the atmosphere, like that produced by hot-air heaters, abnormal patulency of the nares, or anything else that causes a rapid evaporation of the nasal secretions, tends to produce atrophic rhinitis. Bosworth stated that in many instances the disease begins in childhood as a purulent rhinitis. Any infection with bacteria virulent enough to cause destruction of the nasal mucous membrane over comparatively large areas will produce atrophic rhinitis. The writer has seen it occur in the adult as the result of syphilis, and probably the larger majority of cases are the result of the destruction caused by pseudomembranous rhinitis and nasal diphtheria. Suppuration of the accessory sinuses also may be either a cause or the result of atrophic rhinitis, and there is said to be present in most cases the bacillus fœtidus ozænæ, which was formerly thought to be the cause of the disease. Bacteria of various kinds swarm in the semiputrid, half-dried secretions, and the stench is either directly the result of such masses, or may originate from the contents of suppurating accessory sinuses, or from masses retained in the crypts and folds of the third tonsil. The bony structures atrophy as the result of a rarefying osteitis affecting mostly the turbinates.

Pathology.—When the disease is the result of long-continued hypertrophic rhinitis, the pressure of adventitious cellular tissue causes absorption of the glandular elements. The surface of the mucous membrane being thus nearly deprived of its secretions, is exposed to dust and irritants of every kind that accumulate upon it, and with long-retained and rotting semi-inspissated secretions, form bad-smelling scabs and crusts. Owing to pressure from these

scabs, shallow ulcers occur beneath them, while the atrophy progresses until, in some cases, the turbinated bones have nearly disappeared and the septum has become, at certain parts, almost as thin as a sheet of writing paper. It is not uncommon for individuals to present themselves to the surgeon with hypertrophic catarrh existing in one nasal cavity, whilst atrophic rhinitis is present in the other. In such cases there is usully deviation of the septum toward the hypertrophic side. Cases are not infrequently seen with an inferior turbinated body and the adjacent mucous membrane atrophied, whilst the middle turbinated body immediately above is greatly hypertrophied.

Concomitant disease of the ethmoid cells or of some one or more of the other accessory sinuses of the nose is not uncommon in atrophic rhinitis, and it has been claimed that atrophic rhinitis may result from suppuration of one of the accessory sinuses. When superficial necrosis results from bacterial infection the progress of the disease, after the formation of ulcers, is similar to that described above. Retained secretions putrefy and produce a characteristic odor, horribly offensive, the disease being then termed ozena. Similar stenches occur in syphilitics, the stench resulting usually not from fetid semi-inspissated mucus, but from sequestra of dead bone within the nose.

Somewhat numerous varieties of bacteria are found in the secretions of atrophic rhinitis, the saprophytes, or those causing putrefaction, naturally being the most numerous. Attention has not infrequently been called to the large proportion of cases of pulmonary tuberculosis among patients with atrophic rhinitis; for instance, Theisen reports 14 cases of pulmonary tuberculosis among 40 cases of ozena examined. It has been suggested that the large proportion of consumptives is due to the fact that atrophic rhinitis deprives the nose of its power to arrest and destroy the bacteria of inspired air.

Symptoms.—A sensation of dryness and irritation within the nose and pharyngeal vault, with almost constant efforts to remove the accumulated secretions by hawking, spitting, and blowing the nose. The breath is usually fetid, but the patient, because of his defective sense of smell, is un-

aware that his breath is horribly offensive. Upon inspection, the mucous membrane is found dry and glazed, with scabs and pus adhering to certain portions of it. Sometimes the nostrils are so patulous that the posterior pharyngeal wall can be plainly seen through them, and it also is usually in an atrophic condition. Reflex skin rashes and laryngitis are very common as the result of this affection.

Treatment.—The indications are to secure and maintain absolute cleanliness of the nasal mucous membrane, and replace, if possible, the atrophied parts. Cleanliness may

FIG. 64.—Anterior nasal douche and method of using it (Casselberry).

be secured by the patient's use of an alkaline wash. For this purpose Dobell's solution or, in fact, any of the ten formulas mentioned on page 494 answers sufficiently well. When there is considerable trouble in loosening and removing dried secretions, peroxid of hydrogen diluted with 1 or more parts of Dobell's solution may be employed with an atomizer. Not infrequently the spray from an atomizer, in the hands of a patient, fails to dislodge accumulations, and under such circumstances Thudicum's douche (Fig. 64) is a permissible instrument, as in atrophic cases

there is less danger of fluid entering the Eustachian tubes than when the nostrils are blocked by hypertrophies. However, when one side of the nose is wider than the other the douche should always be used from the narrower toward the wider side. A safer instrument for patients' use is the modification of the postnasal syringe shown in Fig. 65. This the patient is easily taught to introduce behind his palate. It is not only safer but more efficacious for removing secretions than the douche. It is nearly as safe as an atomizer. However, the fact should always be remembered that somewhat numerous cases of middle-ear suppurations have resulted from fluid penetrating the middle ear when sniffed from the hollow of the hand, a cup, an Allingham douche, or the use of Thudicum's douche ; and hence these methods of cleansing the nose should not be employed by the patient unless it is absolutely impossible to keep the nose clean by the use of an atomizer. Moreover, when the patient is wearing Gottstein's cotton cylinders within the nose there is usually no trouble in removing with an atomizer the secretions, as crusts usually cease to form.

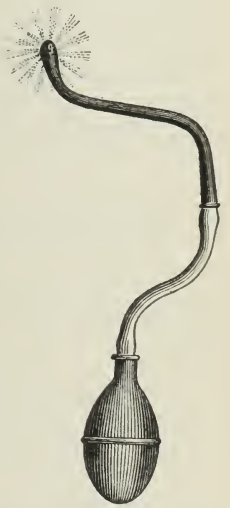


FIG. 65.—Postnasal douche. Modified for patients' use.

For the rhinologist's use in cleansing the nose of an atrophic case the dental bulb syringe (Fig. 38, *c*, with postnasal tip 1) answers the most useful purpose. The distal extremity of the tip should be introduced behind the palate of the patient, who bends his head forward over a bowl. The rhinologist should then compress the bulb with considerable force, so that the fluid (which should be warm) flows in a rapid stream from the nasopharynx through the nostrils into the bowl.

Excellent results follow applications of lignol diluted with an equal quantity of sweet oil (Formula 36). T. Bobone uses for the same purpose :

℞ Petroleum,	gm. 40.00;
Olei eucalypti odoris citri,	gm. 0.50;
Strychniæ nitratis,	gm. 0.02.—M.

Good results follow massage of the atrophied mucous membrane with a cotton-tipped probe.

Powders, possibly because of the mechanical irritation they cause, do good in some cases, and for many years the writer was in the habit of employing a powder composed of a small proportion of nitrate of silver diluted with starch (in the earlier days of rhinology) or stearate of zinc. More recently the main dependence, as far as applications are concerned, has been upon lignol (Formula 36).

The best results are obtained in the treatment of atrophic rhinitis by the use of cylinders of absorbent cotton, as first advocated by Gottstein (Fig. 66), so placed inside the nose

FIG. 66.—Allen's nasal applicator with Gottstein's cotton plug ready to be deposited inside the nose. After the cotton is within the nose the probe is detached from the cotton and withdrawn by turning it in a direction opposite to that by which the cotton was wrapped.

as to perform the functions to a certain extent of the atrophied turbinated bodies. If pharyngitis sicca is present, the cotton cylinders should be of sufficient length to extend the entire length of the nasal floor and project somewhat from the posterior nares. The presence of the cotton cylinders excites the atrophied mucous membrane to renewed action, so that the dried secretions are washed away in the increased discharge and the fetor of the breath corrected. The cotton cylinders soon become soaked with mucus, so that the air passing around them is warmed, moistened, and freed from dust, and enters the pharynx and larynx as if it had passed through a healthy nose. This is the result partly of mechanical irritation and partly of the rarefaction of the inspired air—a factor that should not be overlooked in the treatment of atrophic rhinitis, as irreparable damage results from the removal of an exostosis, especially if located well forward.

A cotton cylinder is easily made by loosely wrapping absorbent cotton about an applicator (Fig. 66) until it has assumed the desired bulk and shape. The cotton is then placed inside the nose and the applicator removed by turning it in a direction opposite to that by which the cotton was wrapped about it. The patient should be taught how to make and place these cotton cylinders inside his nose, and should insert fresh ones as soon as the old are removed by the use of the handkerchief. If worn constantly they cause an immediate change for the better in all the symptoms of atrophic rhinitis and stimulate the renewed growth of the atrophied tissues.

The average case of atrophic rhinitis without disease of an accessory sinus is best treated in the following manner: At the first office visit the nasal and nasopharyngeal mucous membrane is thoroughly cleansed and all adherent masses removed. Lignol (diluted with an equal amount of olive oil) is then thoroughly applied to the entire surface and carefully worked into all angles and spaces, such as those about the remains of the turbinated bodies. At the third or fourth office visit at intervals of three or four days the mucous membrane will have assumed a more normal appearance, and the patient should be taught to make and insert Gottstein's cotton cylinders. As soon as he has learned to do this properly and cleanse his nose efficiently the office visits should be made at less frequent intervals.

He is ordered for home use a wash and instructed how to use it, either with an atomizer or douche. After cleansing the nose he should apply twice a day, by means of a brush, either lignol or Bobone's formula previously referred to. If pharyngitis sicca and reflex laryngeal symptoms are very annoying, small doses of iodid of potash (gr. ii to x, t. i. d.) may also be ordered with advantage to increase the secretions and diminish reflex action.

Prognosis.—Atrophic rhinitis is one of the most unsatisfactory and tedious of nasal diseases to treat. Fetor of the breath and the other more annoying of the patient's symptoms are easily and quickly corrected in the majority of cases by the wearing of Gottstein's cotton cylinders, and

something very like a cure of the disease, after some years, will be finally brought about.

The writer occasionally sees cases that he treated ten or more years ago. Some of these cases are cured to the extent that there is no fetor of the breath or retained secretions requiring removal, except during periods when the patient has caught cold. Others of these cases still wear the cotton cylinders, although not constantly, and by this method and by the use of nasal washes manage to maintain a fair degree of comfort. In some cases there has been a partial restoration of the sense of smell.

It is reported that actual cures have resulted from the employment of the Finsen ray.

Attempts have been made with more or less success to restore the original bulk of the turbinals by the injection of paraffin wax (Formula 96) underneath the nasal mucous membrane.

Syphilitic rhinitis is a diseased condition of the interior of the nose dependent upon the presence of syphilitic virus.

The *synonyms* are syphilitic catarrh or ozena; specific rhinitis; and, according to the stage of the disease, nasal chancre; syphilitic coryza; nasal gumma; tertiary nasal syphilis.

Pathology.—It is exceedingly rare to find the primary lesion of syphilis or chancre existing inside the nose, from the fact that the syphilitic virus is rarely introduced inside the nasal chambers, and that, should such an event occur, the secretions of the parts tend to wash away the morbid matter before inoculation takes place. Secondary lesions of the nasal mucous membrane are analogous to, and often coincide with, those appearing upon the skin. They vary from a mere erythema of the nasal mucous membrane with increased secretion to intense hyperemia and swelling, with the presence of mucous patches or shallow ulcers, secreting a sanious and offensive mucopus. During the tertiary period nasal gummata are by no means rare. They appear as irregular nodulated swellings distending the mucous membrane of any part of the interior of the nose. A nasal gumma may be absorbed, leaving in some instances a characteristic cicatricial contraction, or it may break down

and produce an ulcer, before which the cartilages and even the bony structures of the nose may melt away like wax as the ulceration rapidly extends, thus producing in a marvelously short time the most hideous deformity. Exuberant granulations may spring from the ulcerating gumma and completely fill the nasal chamber or even project from the nares, simulating a malignant growth. When the ethmoid has thus been necrosed and exfoliated, there may remain, after the healing process is complete, but a thin fibrous membrane between the interior of the nose and brain. The lateral wall of the nose may be destroyed entirely, so that the antrum of Highmore and the affected side of the nose become one large cavity. In other instances the septum, nasal processes of the superior maxillary, and the nasal bones may be partly destroyed in such a manner that the nose becomes flattened upon the face, producing a most serious deformity. In aggravated cases the soft parts may also be involved in the process, until finally the anterior nares are represented merely by an irregular hole in the face. During the ulcerative process of a gumma the breath is generally very offensive. Hereditary syphilis pursues the same course as the tertiary form of the acquired disease.

Treatment.—Constitutional treatment is of primary importance. The primary and secondary lesions are probably best treated by the internal administration of a pill containing ¼ gr. of the protoiodid of mercury (Formula 74). The patient may take from one to three of these pills three or four times a day and, if necessary, a sufficient quantity of opium should be administered to prevent their producing diarrhea. The pills are less likely to produce digestive derangements if taken after meals and at bedtime. Any ulceration upon the nasal mucous membrane should be touched every other day with the acid nitrate of mercury (1 part to 4 parts of water) until they are healed; and the inflammation treated in the meanwhile as a case of simple chronic rhinitis. However, although the applications of acid nitrate of mercury are effectual in bringing about a rapid healing of the ulceration, they are somewhat painful ; and if the patient complains bitterly of the pain, a solution of nitrate of silver (60 gr. to 1 ounce) should be substituted

or the ulcerations merely may be dusted with powdered calomel.

In tertiary syphilitic rhinitis the *mixed treatment* answers a very useful purpose, for, while the iodid of potassium is not a specific in syphilis in the sense that mercury is, yet it gives a much quicker result in controlling tertiary manifestations. One, two, or three teaspoonfuls of Formula 73 may be given three or four times a day, according to the emergencies of the case and the patient's susceptibility to mercury. Mercury may also at the same time be administered by inunction or fumigation, or, in cases where the most speedy effect possible upon the syphilitic lesion is desired, it may be administered hypodermically. From 8 to 20 minims of Formula 76 should be injected into the cellular tissue of the back every day or at less frequent intervals. If thrown into the cellular tissue of the back, a solution of corrosive sublimate not stronger than that of Formula 76 will not produce an abscess, but causes some pain. The first injection should be given deep into the cellular tissue beneath the skin under one shoulder-blade; the second injection, beneath the skin of the other shoulder-blade; the third, 4 inches below the first; the fourth, 4 inches below the second, and so on down the back. But a few hypodermic injections are ordinarily required to limit the spreading of a gummatous ulcer, which speedily assumes a more healthy appearance. In cases where gummata are so situated as to cause obstruction to nasal respiration, pain, and intense headaches from pressure, the action of medicines upon the growth are too slow and operative procedures must be resorted to. A gumma may be removed from a turbinated bone with the snare or scraped from the septum with a large nasal curet. Such operations, however, should not be performed upon patients of debilitated constitutions, or those who are not, or cannot quickly be brought under the influence of mercury, as otherwise the wound made by the operation will not heal and may result in extensive ulceration. When a nasal gumma has broken down and is ulcerating the parts should be kept scrupulously clean by the use of an antiseptic solution (Formulas 1 to 10), and the wound stimulated to heal by the daily application of acid

nitrate of mercury diluted with 4 parts of water. Wounds resulting from operations upon gummata should be treated in the same way until the healing process is complete.

Tubercular rhinitis is an inflammation of the interior of the nose characterized by the presence of the tubercle bacilli.

Etiology.—The disease is usually the result of the inoculation of the nasal mucous membrane by morbid material from another portion of the body of a tuberculous individual.

Pathology.—The most common lesion observed is a small ulceration, usually on the septum or floor of the nose. Occasionally hyperplastic nodules and papillomata, pale in color and either pedunculated or sessile, are observed.

Symptoms.—Crusts form upon the ulcerations and are blown from the nose. The ulceration may progress to perforation of the septum. The hyperplastic growths sometimes attain sufficient size to cause nasal obstruction.

Diagnosis.—The disease in its ulcerative form somewhat resembles syphilis. However, as it rarely occurs except in individuals with advanced pulmonary tuberculosis, the diagnosis usually is easy. The surrounding mucous membrane usually is much paler than in syphilis; indeed, the whole mucous membrane of the nose is usually anemic. However, in doubtful cases, iodid of potassium exhibited for a few days in 10-gr. doses every three or four hours will usually decide as to whether syphilis is the cause of the ulceration. Papillomatous outgrowths examined microscopically show the presence of tubercle bacilli.

Treatment.—The local treatment consists of cleanliness of the nasal cavities brought about by the patient's use of an atomizer containing an alkaline wash, followed by spraying the nose with menthol-camphor-albolene. The physician may cleanse the ulcerations and touch them with solid nitrate of silver fused on the end of a probe (Fig. 55). Large papilloma may be snared, but it is advisable to do no unnecessary surgery in a tuberculous nose. As the disease rarely if ever occurs except in advanced pulmonary tuberculosis, the general treatment is more important than the local.

Lupus.—The name lupus is applied somewhat loosely to various skin diseases: Lupus erythematosa, lupus congestiva, lupus superficialis, lupus sebaceus. Lupus erythematosa first appears as grouped red spots that ultimately coalesce into slightly raised patches. The initial lesion is always erythematous and, unlike lupus vulgaris, there is no tendency toward ulceration.

Lupus vulgaris sometimes originates at the tip of the nose, either upon the mucous or, more often, on the skin surface.

Etiology.—The cause of the disease is tubercle bacilli.

Pathology.—The lesion manifests itself as reddish-brown nodules. These atrophy, leaving scars, or ulcerate, involving sometimes large areas of skin, mucous membrane, and cartilage. A large portion of the tip of the nose and septum may be destroyed. The ulcer is often covered by a brownish scab; when this is removed the ulcer appears filled with a granular "apple-jelly"-like mass, which can be readily scraped away with a curet. Deep cicatrices and deformities result from the healing of the ulcer. It may cicatrize at one extremity while the progress of the ulceration is active at the other. The disease is uncommon in America.

Diagnosis.—Lupus so much resembles syphilis that the diagnosis usually has to be established by the "therapeutic test," which consists in the exhibition of iodid of potassium. From epithelioma it is differentiated by the microscopic findings.

Treatment consists in the daily application of the *x*-ray.

Rhinoscleroma is a disease of the mucous membrane of the nose extremely rare in North America, but occurring in Brazil, Russia, Italy, and other countries.

Etiology.—According to some authorities the disease is the result of the presence of a characteristic bacillus.

Pathology.—The disease produces nodular hypertrophies on the nose and sometimes within the nose, pharynx, and larynx. Ulcers appear upon the mucous surfaces resembling the lesions of tertiary syphilis. The contraction of dense cicatrices sometimes results in deformities.

Symptoms.—There is little or no pain at any stage of the disease. The growth inside the nose may interfere with nasal respiration, and when the mouth and pharynx are in-

volved it may be impossible for the patient to swallow solids. Involvement of the larynx may be sufficient to interfere with respiration as the result of cicatricial contraction.

Treatment.—As the disease has a tendency to recur, operative interference is inadvisable, except tracheotomy when necessary to prevent death from stenosis of the larynx. Lang recommends salicylic acid locally and in 10-gr. doses internally.

Foreign Bodies in the Nose.—Children and insane persons occasionally insert into their noses buttons, cherry-stones, beads, beans, twigs, hair-pins, etc. Necrosed bones, when detached, act as foreign bodies and produce their characteristic symptoms. Rhinoliths, ascarides, and maggots are also found in the nose, and may be considered as foreign bodies.

Symptoms.—Obstructed nasal respiration proportionate to the size of the foreign body. If the foreign body is large or causes pressure, headache and pain of a neuralgic character are complained of. At first the presence of a small foreign body in the nose of a child attracts but little attention unless the child tells its parent there is something in its nose. After a time a discharge of glairy mucus occurs, which excoriates the skin of the lips and alæ, but the discharge soon becomes purulent and may be streaked with blood and be fetid. A one-sided discharge from a child's nose is almost pathognomonic of a foreign body, and under such circumstances the most careful and painstaking search should be undertaken to discover the offending particle.

Rhinoliths generally contain as a nucleus a foreign body around which the nasal secretions accumulate and deposit a coating of earthy salts, gradually increasing in thickness. The presence of a rhinolith causes practically the same symptoms as that of a foreign body of similar size and shape.

Treatment.—The foreign body or bodies should be removed as soon as possible. This may be accomplished by means of a pair of forceps or a blunt ear curet.

Rhinoliths may sometimes be removed whole or may have to be broken up by means of a powerful pair of forceps in order to remove them from the nose.

Neuroses of the Nose.—Motor Neurosis.—Twitching of the nose and eyelid is generally due to peripheral irritation of some branch of the facial nerve. It occasionally occurs as the result of the application of the galvanocautery to an anterior hypertrophy.

Paralysis of the dilatores nasi produces a collapse of the lateral walls of the anterior portion of the nose that decidedly interferes with nasal respiration. Unilateral paralysis of the dilator nasi occuring in childhood, according to some of the older writers, is one of the causes of deviation of the nasal septum. The partial stenosis in long thin noses, due to the valvular action of the anterior portion of the sides of the nose by which inspiration is impeded, can be entirely alleviated by cutting a strip of requisite length from a visiting card, bending it, and placing it with its ends up inside the vestibule of the nose in such a manner that it acts as a spring holding the anterior nares open. However, in such cases the valve-like action of the anterior portion of the sides of the nose disappears permanently in many instances by increasing the breathing space by the removal of a small ecchondrosis from the septum or cauterization.

Sensory Neuroses.—*Anosmia*, or complete loss of the sense of smell, may be congenital or acquired. If acquired, the condition may be due to syphilis, hysteria, or result from lesions of the olfactory bulbs produced by meningitis, tabes, or the pressure of a brain tumor. Disturbances of the sense of smell amounting to almost complete loss occur from any cause that prevents odorous particles reaching the portions of the nose where the peripheral nerve-endings of the olfactory nerves are distributed.

An ordinary cold, hypertrophic rhinitis, or polypi frequently cause mechanically greater or less loss of the sense of smell, which returns after the mechanical obstruction is removed. In atrophic rhinitis affecting the vaults of the nasal chambers there is generally great impairment of the sense of smell, which in some cases is partly restored when crusts and accumulations no longer form. In purulent inflammation of the ethmoid cells, especially in those cases where the middle turbinates are sufficiently swollen to press on the septum, great impairment of the

sense of smell is usually present. In such cases the prognosis is not entirely unfavorable.

Hyperosmia is an increased sensibility of the olfactory apparatus. The ability to detect odors, generally stenches, is intensified. The condition is sometimes observed in nervous women.

Parosmia is a perversion of the sense of smell associated with local or systemic disturbances, insanity, etc. The sensation of a bad odor is sometimes a part of the aura of epilepsy.

Hyperesthesia and *anesthesia* of the nasal mucous membrane are occasionally encountered.

Paresthesia, or the sensation of imaginary stenosis or foreign bodies in the nose, occurs in a certain proportion of neurotics. It is not an unusual thing for such patients to complain of stenosis when the condition present is atrophic rhinitis with widely patulous nasal chambers.

Reflex nasal neuroses are asthma, sneezing, cough, and certain skin rashes upon the nose and sides of the face. Cases of epilepsy have been reported as greatly improved, possibly cured, by the removal of nasal growths.

The most common condition found in asthma of nasal origin is nasal polypi; but semi-occasionally asthma is greatly alleviated by the removal of a septal exostosis or even by bringing about an improved condition of the nasal mucosa when no gross lesions are present.

Hay-fever, or coryza vasomotoria periodica, is a chronic nasal affection depending upon a disturbance of the entire nervous system, and particularly of the various nerves supplying the nasal mucous membranes, and characterized by periodic exacerbations caused by inhaling dust or other irritants.

The *synonyms*—hay-asthma, autumnal catarrh, rose cold, horse cold, cow cold, peach cold, snow cold, miller's asthma—are names given to the affection and supposed to indicate the irritant which is the direct cause of an attack of the disease.

Etiology.—There are three factors in the causation of an attack of hay-fever, viz.: First, a pathologic condition of the nasal chambers; this may comprise anterior or posterior

hypertrophies, exostoses, ethmoiditis; but more especially the presence of hypersensitive areas, readily distinguished by their heightened color and slight elevation above the surrounding mucous membrane. Irritation of one of these spots with the end of a probe, even during the winter time, will bring on an attack of hay-fever lasting from an hour to several days; second, a diseased or, at least, an irritable condition of certain nerve-centers, giving rise to a train of near and remote symptoms by reflex action; third, the presence of an external irritant. *The absence of any one of these factors is sufficient to prevent an attack.*

Symptoms of an attack of vasomotor coryza are those of coryza—a sense of dryness and itching in the nose, violent sneezing, occlusion of the nares, and profuse watery discharge. These symptoms are usually followed by conjunctivitis, lacrimation, photophobia, headache—often of a neuralgic character—a hacking cough, asthma, and a general feeling of malaise.

Treatment.—The most effective treatment of periodical hyperesthetic rhinitis is a sea-voyage, lasting through the entire hay-fever season or residence in a region free from the presence of irritating pollens and dust, like that of the White Mountains of New Hampshire.

For professional and business men, however, such a treatment involves hardships and loss of business opportunities that render it acceptable only as a last resort. Therefore any treatment that will enable the sufferer to remain at home in comparative comfort and attend to business is eagerly sought by the majority of workers suffering from hay-fever.

The attention of the profession, chiefly through the writings of Seth Scott Bishop of Chicago, has been directed to the fact that the neurotic condition of the patient and the hypersensitiveness of the nasal passages were often due to an excess of uric acid in the blood, and that this excess could be eliminated by the ingestion of mineral acids.

Probably any mineral acid would prove efficacious, but there are two which suggest themselves as peculiarly efficacious: hydrobromic acid, because of its sedative qualities, and nitromuriatic acid, because it is thought to limit the production of uric acid.

The writer's experience has been limited to the effects of nitromuriatic acid, which has been prescribed in doses of 5 to 10 drops of the freshly prepared concentrated acid after meals and sometimes also at night. The dose should be diluted with one-half tumblerful of water, and the patient, after taking the medicine, should rinse out his mouth and swallow another half-tumblerful of water.

The results of the remedy are apparent within forty-eight hours, and the relief of all hay-fever symptoms are usually sufficient to enable the patient to remain at home and attend to his ordinary business engagements in comparative comfort. If, however, a simple dose is omitted, some symptoms of hay-fever will appear within the succeeding twenty-four hours. This is especially true if the remedy is not taken after the evening meal, as, under such circumstances, the patient usually wakes up the next morning with occluded nares and suffused eyes.

Between the attacks of hay-fever measures should be adopted to improve the patient's general health and correct any abnormality of the interior of his nose. The practitioner, however, should not be too sanguine as to the beneficial results to be obtained by such measures, for it should be borne in mind that hay-fever not infrequently occurs in vigorous individuals the interior of whose noses present no gross abnormality except during the hay-fever season.

There is, however, one condition of the nose that is apparently present in all individuals suffering from hay-fever, and that is the presence of hyperesthetic areas upon the respiratory portion of the nasal mucous membrane, which when touched with a probe cause sneezing and lacrimation.

The hypersensitive condition of such areas may be destroyed one or two at a time, even during the hay-fever season, without adding to the discomfort of the patient by either palliative or radical methods.

The palliative method consists of cocainizing the nose and touching the sensitive area with a 10 per cent. solution of chromic acid applied by means of a cotton-tipped probe. The radical method consists in destroying the sensitive area

by means of the galvanocautery. A small cautery-knife should be selected, and the current should be sufficiently strong to instantly bring its tip to a white heat. After cocainizing the nose, the cautery tip is moved over the mucous membrane until a sensitive area is discovered. The current is then turned on for an instant and the cautery-knife withdrawn. Very little destruction of the membrane results, and should hemorrhage occur no undue haste should be used in controlling it, as the local depletion is beneficial rather than otherwise.

Temporary relief may be obtained during the worst stages of the attack by spraying the nose with a weak alkaline 1 per cent. solution of cocain, and afterward with fluid vaselin as a protective. It is, of course, justifiable to use cocain during an office treatment, but cocain should not be prescribed for the patient's home use, as hay-fever victims are (often because of the neurotic temperament) the class of people most liable to contract the cocain-habit.

As a home treatment the patient may spray the nose every hour or two, if necessary, with a solution of adrenalin hydrochlorate in the strength of 1 : 10,000 or 1 : 20,000. When the writer first began using this drug his results were not altogether satisfactory. Temporary relief was always obtained to a greater or less extent, but the use of the stronger solutions was always followed by a reaction similar to that of cocain solutions. The results have been vastly better since very dilute solutions at frequent intervals have been employed. The solution should be freshly made and free from antiseptics, and for these reasons the drug is best prescribed for patients' use in the form of a small tablet which when dissolved in the proper amount of water forms a solution of the required strength. However, in many instances oily preparations are more efficient than watery solutions, and an ointment made up with lanolin and vaselin of a strength of 1 : 10,000 is of decided value. It is conveniently dispensed in collapsible tubes, so that the patient can carry it about in his pocket and squeeze out from the tube from time to time the amount of ointment required. A piece the size of a pea may be inserted into each side of the nose every two hours by a brush or simply with the tip

of the little finger. The head is then thrown back until the ointment melts and distributes itself over the nasal mucous membrane.

After the attack has subsided, all pathologic conditions of the nose should be removed, and the sensitive areas cauterized with a small galvanocautery-knife, so introduced that its flat surface will rest upon the sensitive areas and make a *superficial* burn.

Professor Dunbar, of Hamburg, has prepared hay-fever *antitoxins* by the inoculation of horses with the toxins obtained from the albuminoid body found in the starch particles of pollen. The serum obtained from the horse is dispensed either in a liquid or dry form, and is designed to be applied to the mucous membranes of the nose and that of the eyes when required.

The serum has been named *Pollantin*, and two forms are on the market, one prepared from rye pollen, especially used for spring and summer hay-fevers or "rose colds," and the other, prepared from ragweed pollen, designed as a remedy for the hay-fever occurring in the late summer and fall.

Dunbar believes that hay-fever is the result of a specific poison found in pollens, and his antitoxin is designed to immunize patients against pollen toxins when used previous to the hay-fever season and also to palliate the symptoms in cases where the disease has already made its appearance.

When applied to the inflamed mucous membrane of the nose or eye pollantin produces a sensation of ease and comfort which persists for some time.

Prognosis.—It is not unfavorable. Many cases completely recover. The patient should be kept under observation and occasionally treated for at least three years after an apparent cure to prevent the danger of a relapse.

Nasal hydrorrhea is a disease characterized by a clear watery discharge from one or both nostrils as the result of some irritation or disturbance, either peripheral or central, of the vasomotor supply of the nasal mucous membrane.

Etiology.—In one class of cases the flow of fluid from the nose is perfectly passive and causes no inflammation.

The phenomenon is probably due in such cases to a paresis of the nasal branches of the trifacial nerve, which exercises an inhibitory action upon the normal exosmosis of serum in the nasal mucous membrane. In a certain number of these cases the fluid discharged has been claimed to be cerebrospinal fluid, by some pathologic process a communication having been established between the nose and the subarachnoid space.

In a second class of cases the flow of serum is accompanied by great congestion and swelling of the Schneiderian membrane, and the phenomena are the result of an irritation of the vasomotor nerves. In this second class of cases the congestion and inflammation of the nasal mucous membrane and the consequent watery discharge are greatly increased by cold and by inhaling dust and other irritants. Indeed, the symptoms are somewhat similar to those of hay-fever.

Symptoms.—In the first class of cases there is an almost constant dropping of a clear watery fluid from one or both nostrils. In the second class of cases the discharge is more remittent in character, according to the amount of irritation of the Schneiderian membrane.

Treatment.—In some cases adrenalin acts as a specific. A solution of the strength of 1 : 20,000 up to 1 : 1000 should be sprayed upon the nasal mucous membrane sufficiently often to control the symptoms. From 2 to 5 gr. of the extract of suprarenal capsule also should be taken every three hours, the patient being instructed to cease taking the remedy should disagreeable heart symptoms manifest themselves. In some cases a cessation of the discharge occurs within a few days, and the use of the remedy should then be discontinued.

As the cause of this disease is generally somewhat obscure, the treatment is necessarily expectant. The discharge terminates in some instances as abruptly as it began, almost without medication. Atropin sometimes is more useful than the extract of suprarenal capsule; a pill containing $\frac{1}{200}$ gr. may be given every three or four hours. In patients who can be trusted to barely moisten their mucous membrane with the spray from an atomizer co.n-

taining $\frac{1}{4}$ gr. of atropin to 1 ounce of water, and not use the atomizer sufficiently often to cause poisonous effects, a spray acts far better than when atropin is taken by the stomach. The patients, of course, should be cautioned as to the very active nature of the poison and cautioned against using a sufficient amount of spray to reach the pharynx. It should be borne in mind that 10 drops of the solution contain $\frac{1}{200}$ gr. of atropin, and this amount (applied to the nose) never should be exceeded. Sometimes astringents applied locally answer a useful purpose, and an ointment of gallic acid (10 gr. to 1 ounce of vaselin with 1 or 2 gr. of menthol) may be prescribed with benefit.

Nasal Hemorrhage.—The *synonyms* are epistaxis; rhinorrhagia; nosebleed; hemorrhagia narium.

Etiology.—It is an old saying that recurrent hemorrhage from the nose may be a warning, a remedy, or a disease.

The bleeding may be the result of some disease of the blood, of which the most common are plethora, anemia, hemophilia, and the condition of the blood brought about by typhoid and the eruptive fevers. Diseases of the blood-vessels, the result of atheroma or syphilis, are predisposing causes, while the increased blood-pressure resulting from Bright's disease and organic disease of the liver, heart, lungs, or kidneys are frequently early manifested by bleeding from the nose. Recurrent noseblood has hence been occasionally arrested by applying a blister over the liver, and in all cases the possibility of disease of some vital organ should be investigated and, if necessary, the proper remedy applied as a part of the treatment of nosebleed.

No good observer probably has failed to be impressed with the very evident correlation existing in most of our domestic animals between the nose and the sexual organs exhibited during the rutting season. Similar phenomena occasionally are observed in the human race, and many amusing stories are told in illustration.

Erectile tissue occurs in but three portions of the human body: the nose and throat, the nipples, and the sexual organs. In the male, puberty is accompanied by a change of voice, and nosebleed is not uncommon at this time in either sex; in the female, sometimes as a vicarious men-

struation. Recurrent nosebleed is said to be aggravated by masturbation.

Ulcerations and neoplastic growths within the nose are sometimes hemorrhagic. Angiomata, carcinomata, sarcomata, and especially fibromata frequently bleed at the slightest touch. Severe and repeated nasal hemorrhage, when it occurs in a youth with a nasopharyngeal fibromata, is almost diagnostic of the latter.

Traumatism is a frequent cause of hemorrhagia narium. If the blood flows from each side of the nose in equal amounts, it is somewhat suggestive of injury to the vault of the pharynx or even fracture of the base of the skull; because hemorrhage from injury to the nose alone is usually unilateral. However, blood from the nose may be swallowed or drawn into the bronchi and afterward coughed up or vomited in a manner suggestive of a pneumonic or stomachic origin of the hemorrhage. It is not always easy to make a diagnosis between bleeding from the vault of the pharynx and hemoptysis.

The nasal vessels are not supported by a muscular cushion into which they may be crushed by a blow, but lie in more or less intimate contact with bone or cartilage and are only protected by extremely delicate mucous membrane, and hence a slight injury is sufficient to cause hemorrhage, which is profuse and long continued, because the proximity of bone or cartilage prevents the ends of the severed vessel from contracting as readily as if they were imbedded in soft tissue. When sawing exostoses from the septum an artery within the bone is occasionally encountered; and because the end of the vessel is held wide open by its attachments to the bone hemorrhage is invariably profuse and long continued. Such cases invariably require radical measures to control the flow. Fortunately, however, arteries within such growths are comparatively rare. Since the use of adrenalin solutions before nasal operations it is said that secondary hemorrhages after nasal operations are more common. The usefulness of this drug, of course, has its limitations. Its effects only penetrate a certain depth into the tissues and it, of course, has no effect on a vessel deeply imbedded in bone.

The *prognosis* of all forms of nasal hemorrhage is generally favorable, but few fatal cases having been reported.

Pathology.—The great vascularity of the nasal mucous membrane readily explains the great frequency of nasal hemorrhage. In most cases of spontaneous origin the bleeding is from the neighborhood of the septal artery—*i. e.*, from the anterior part of the septum. Wounds resulting from surgical operations upon this portion of the nose frequently bleed profusely, although an artery is sometimes observed to "spurt" in the wound of an operation done further back upon the septum, while spontaneous bleeding may occur from posterior hypertrophies or adenoid vegetations. In such cases the blood flowing downward into the fauces is expectorated and is frequently mistaken for a hemorrhage from the lungs.

Treatment.—If after an operation severe hemorrhage has occurred, and it is known from what spot the bleeding occurs, a small mass of absorbent cotton should be tightly wedged within the nose over the bleeding vessel.

Bleeding may occur from any portion of the nose, but it is most common from the anterior portion of the septum. In cases of recurrent nosebleed, if the alæ be pulled to one side within a day or two after an attack, a small clot, a yellow spot, or a varicose condition of the veins upon the septum will mark the seat of the hemorrhage. Under such circumstances the patient should be directed to apply daily, by means of a brush, an ointment of gallic acid (10 gr. to 1 ounce of vaselin), and to avoid violently blowing the nose. Should the vessels be very numerous and varicose, this treatment will hardly suffice, and it will be necessary to destroy the vessels by a touch of the galvanocautery or chromic acid. It is not well to apply the galvanocautery or chromic acid too vigorously, as the cartilage of the septum has not much vitality, and too vigorous application of the acid may result in a perforation. Simply singe the *mucous membrane* lightly with the flat side of a small cautery-knife. A whitish spot upon the mucous membrane and the disappearance of the outline of the vessel indicates that the burn will be effective.

Occasionally recurrent nosebleed is the result of a small

ulceration or erosion of the mucous membrane of the anterior portion of the septum, generally in a hollow caused by a slight deviation of the septum or a cartilaginous spur or outgrowth within the nose. Because of the hollow upon the septal wall, mucus dries until the bulk becomes sufficient to extend above the hollow into the air-current, when it is dislodged by violently blowing the nose or by sneezing. Under such circumstances a minute portion of mucous membrane is carried away with the inspissated mucus and a hemorrhage occurs. Sometimes the hemorrhage occurs from dislodging such masses of mucus with the finger-nail. The patient should be cautioned against picking his nose, as under such circumstances the resulting ulceration becomes deeper, until finally it extends entirely through the septum and a perforation results.

Generally the formation of crusts and scabs can be prevented by frequent applications of carbolized vaselin, but should this not suffice, the hollow in the septum must be eradicated by suitable operative procedure. The usually slight bleeding from anterior ulcerations, as it occurs from time to time, can be controlled by grasping the tip of the nose firmly between the thumb and finger, or the insertion of a small piece of ice within the naris, or by applying an ointment of adrenalin on absorbent cotton.

This brings us to the consideration of the control of severe nasal hemorrhage. In such cases such remedies as adrenalin are useless, because the flow of blood prevents their coming into contact with the mucous membrane and exerting their effects; nor is it possible, in most instances, to accurately locate the bleeding spot and apply pressure to it directly. Usually the patient is found bending over a bowl upon his lap or he may be resting upon the bed in such a position that his head leans over its side so as to allow the blood to drip into a receptacle upon the floor. Have him at once sit erect, propped up with pillows, if necessary, with his head neither thrown back nor forward, and instruct him to hold a finger-bowl under his *chin* (not nose) to catch the flow of blood.

This change of position takes off pressure from the veins in the neck and may be all that is necessary to stop the

hemorrhage. If this be the case, a little pledget of absorbent cotton, saturated with vaselin, should loosely be inserted within the naris to support the clot and prevent the patient breathing through that side of the nose.

If in spite of the change of the patient's posture the blood should continue to flow, it will be necessary to apply pressure to the bleeding vessel. This is most expeditiously, painlessly, and effectually accomplished by adding peroxid of hydrogen to the clot within the nose, which hardens it and causes an increase of many times its original bulk. Wrap a piece of absorbent cotton loosely about an Allen's probe so that it forms a cone 3 inches in length and 1 inch in diameter at its proximal extremity (Fig. 67). Thrust

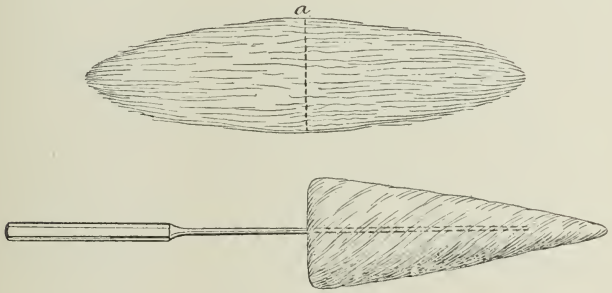


FIG. 67.—Method of making pressure-cone of cotton for the control of nasal hemorrhage. A piece of absorbent cotton (*a*) is frayed at each end into a thin edge, folded through the middle (dotted line *a*), and loosely wrapped about a nasal applicator in such a manner as to form a cone. This is dipped into peroxid of hydrogen and inserted within the nose.

this, dripping with peroxid of hydrogen, along the floor of the nose until the pharynx is reached. Place the fore-finger-tip against the cotton within the nose and withdraw the probe, leaving the cotton in position supported by the finger-tip until the pressure caused by the ebullition of gas has somewhat subsided, then withdraw the finger and support the first pledget by means of a second plug of cotton saturated with peroxid of hydrogen. This is pressed firmly into the naris, especial care being taken that it firmly fills the space within the extreme tip of the nose, or blood will escape over the cotton plug. If required, a third or even a fourth plug of cotton may be used.

When everything is ready, the whole maneuver can be executed in less than one minute, and the bleeding is instantly checked. If, after a minute or two, the fraction of a drop of blood shows itself oozing through the cotton, it should be coagulated by touching it lightly with Monsell's solution, and the process repeated from time to time if necessary. It is well, indeed, to smear the whole of the presenting surface of the cotton with the solution of the perchlorid of iron, which dries with a little blood into a black impenetrable varnish, and allows no blood to trickle. Never apply any of the iron salts *inside* the nose to control hemorrhage, as they are extremely irritating and form a sort of sticky black sand difficult to remove.

It should be remembered that it is not the peroxid nor the pressure of the cotton, but the pressure of the firm clot which forms within and about the cotton that checks the hemorrhage; therefore the cotton should be wrapped about the probe with only sufficient firmness to enable it to retain its conic shape when passed along the floor of the nose. Within certain limits, the more loosely the cotton is wrapped the more peroxid it will take up and the more readily blood will enter its meshes. The conic shape of the mass facilitates its passage through the posterior naris, which, with the aid of a clot, it firmly closes. This method of controlling nasal hemorrhage is much less irritating than most others employed; but at the end of five or six hours swelling of the mucous membrane will have occurred to a sufficient degree to render the packing within the nose somewhat uncomfortable, and it is generally advisable and safe to remove the outer plug. This should be done with extreme gentleness, avoiding any sudden pull or jerk. At the end of twelve or twenty-four hours the larger mass of cotton can often be removed with safety if done in a proper manner. Avoid removing pressure too suddenly or the hemorrhage will certainly recur and the packing will have to be replaced. It is well to have at hand a smaller cone of cotton saturated with peroxid to instantly replace that removed should this accident occur. Grasp the end of the mass of cotton to be removed with a pair of dressing-forceps and draw it forward $\frac{1}{8}$ inch, then wait five minutes.

Repeat this procedure at intervals of five minutes until the mass is coaxed, as it were, from the nose. If, during this process, a drop of blood shows itself, cut off with a pair of bandage-scissors that portion of the cotton already outside of the nose and press into the vestibule a little mass of fresh cotton saturated with peroxid. Be content to wait for an hour or so before again trying to remove the packing; for, at any rate, you have diminished the pressure within the nose and rendered your patient more comfortable. If, however, you have succeeded in removing the whole of the cotton without the hemorrhage recurring, place a little cotton in the vestibule of the naris and allow your patient to rest for a half-hour or so before permitting him to blow out the clot—which should be done with great gentleness. It is advisable in all cases to remove the packing from the nose at the end of forty-eight hours, as by that time it will be extremely foul smelling and there is danger of sepsis. If necessary to check the recurrent hemorrhage, the nose can be packed again with cotton saturated either with peroxid or cosmolin, which, next to peroxid, is probably the best hemostatic for use within the nose.

In most works on surgery an instrument called Bellocq's cannula is figured, by means of which the posterior nares may be plugged by drawing a mass of cotton or other material through the mouth behind the soft palate; if at hand, this instrument may be used. A simpler plan is to insert a Eustachian catheter through the nose and pass a catgut suture string or well-waxed piece of stiff silk or linen suture through it until its end appears in the fauces, when it may be seized by a pair of forceps and drawn out through the mouth. A piece of iodoform gauze should then be tied to the middle of the catgut string or waxed cord, and drawn up behind the palate into the vault of the pharynx in such a manner that one end of the string projects from the nose and the other from the mouth. The ends of the suture material may now be tied together so that the cotton plug is firmly held in position. If a Eustachian catheter is not available, a silk suture may be tied around the eyelet of an ordinary soft-rubber urethral catheter, which is then passed through the inferior nasal chamber until the suture

and catheter appear in the pharynx. However, plugging the posterior nares is seldom, if ever, necessary to check hemorrhage from the nose, but may be used where ether is administered to prevent blood flowing into the pharynx during an operation upon the interior of the nose.

In hemophilia, after the nose has been packed with absorbent cotton and peroxid, 10 gr. of gallic acid or 20 drops of fluidextract of ergot may be given every two hours. Very satisfactory results follow the use of chlorid of calcium, 5 to 10 gr. every two hours may be given in capsule or dissolved in a little water. Some authors emphasize the importance of large doses, and as much as 40 gr. have been given once daily by the mouth or rectum.

Recently Merck has introduced a new remedy for the control of hemorrhage called stypticin, said to be cotarnin hydrochlorate. A useful formula in nosebleed is:

℞ Stypticin, gr. xxiv;
Fluidextractum ergotæ, ʒvj;
Vin. ergotæ, q. s. ad. ʒij.—M.

Sig. Of which a teaspoonful every two or three hours may be given until the hemorrhage ceases.

TUMORS

Nasal Polypus.—The most common growths to be found within the nose are myxoma or mucous polypus, fibroma or fibrous polypus, cyst, ecchondroma, exostosis, osteoma, papilloma, angioma, sarcoma, and carcinoma.

Fibrous polypi differ from the soft or mucous polypi simply because of the proportion of fibrous material each contains. Instead of being soft, gelatinous, and highly hygrometric, fibrous polypi are hard and fibrous. They usually have their attachment in the upper posterior portion of the nasal chambers. When attached to the junction of the nose and pharynx the fibrous tissue is so abundant that the resulting tumor is a true fibroma almost as hard as bone. Nasopharyngeal fibroma are extremely vascular, bleeding sometimes at the slightest touch. Sometimes they hang down from the vault of the pharynx so as to be plainly visible through the mouth, and may send prolongations into the nose and all of the adjacent cavities, either bending around

obstacles or eroding their way through them, enlarging the nasal chambers, thinning the bones, and broadening the bridge of the nose as they grow; causing great deformity or what is sometimes called "frog face." Fibrous polypi are probably local hypertrophies of the mucous membrane and submucous tissues that have undergone fibrous change.

Mucous polypi most frequently originate from the middle turbinated region of the nose. Here the mucous membrane possesses low folds. It is thin, the subepithelial tissue loose and abundant, and the erectile tissues scanty. The mucous glands on the lateral surface of the middle turbinates are numerous.

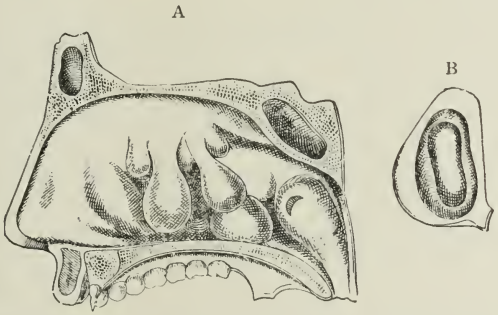


FIG. 68.—A, Mucous polypi in the nose; B, anterior view of same, normal size (Sajous).

As the result of chronic inflammation from any cause the normal folds of mucous membrane become edematous. This edema is favored by the dependent position of the parts until it is sufficient to develop into mucous polypi. The normal active glands of the middle turbinated region prevent the occurrence of edema, but when the glands cease to act as the result of degenerative changes edema results.

Nasal cyst usually occurs as a large sessile bladder, filled with a thin, watery, mucous fluid, and attached to the inferior turbinated bone.

Etiology.—Any long-continued irritation of the nasal mucous membrane may result in polypi. The most common causes are ethmoiditis or defective nasal drainage, as the result either of bony ridges on the septum, a deviated septum, or of hypertrophies of the lower turbinated bone.

Treatment.—Removal of the nasal polypi and the cause that produced them, in the manner described in the sections upon Ethmoiditis and Hypertrophic Rhinitis. The mere removal of the polypi is usually only the first step toward bringing about a cure of the nasal disease. Simple removal is usually followed by a relapse into the former condition. Therefore after the removal of the growth the surgeon should not be content until the parts from which they grew have firmly cicatrized, and it is well even then to see the case once every three months in order to ward off a possible relapse by snaring off promptly any small polypus or bud, which may be the first tendency exhibited toward a relapse into the former condition.

As *nasopharyngeal fibromata* consist of fibrous tissue containing numerous large blood-vessels which (because of the hardness of the tissue in which they are imbedded cannot contract) when severed bleed profusely, such tumors cannot readily be severed by an ordinary snare. The best imported steel piano wire usually snaps during the attempt, or the snare may be twisted into a corkscrew shape if an attempt is made to tighten the wire by turning the screw of the instrument with a wrench. The growth is, however, readily removed by means of a galvanocautery snare with its red-hot wire. Relapses are common, although the disease generally attacks children, and there is a distinct tendency toward slower growth of the tumor as the individual advances in years.

When the galvanocautery snare cannot be used, a pointed cautery-knife (Fig. 58) may be pushed through the tumor toward the center of the growth and heated while *in situ*. The current of electricity should be turned off as soon as the patient complains greatly of the heat and after an interval turned on again. This may be repeated several times before the cautery-knife is finally withdrawn from the growth, which should be done with gentleness and care while the current is turned on in order to avoid hemorrhage. The procedure is less painful than electrolysis and results in a greater amount of shrinking of the growth.

Nasal Papilloma.—Nasal papillomata are wart-like growths most frequently attached to the septum or inferior turbi-

nated bodies. Nasal papillomata are generally abundantly supplied with capillaries and some of them bleed at the slightest touch.

Treatment.—They should be removed with the snare and the place of their implantation touched with the galvano-cautery to prevent a recurrence.

Nasal Sarcoma.—Sarcoma within the nose present the same pathologic characteristics as when present elsewhere. It may occur as a primary growth or result from the degeneration of fibrous polypi or papillomata. A nasal sarcoma is generally sessile and of a light reddish color. In children they grow very rapidly and are prone to ulcerate, with the result of producing a fetid greenish or bloody discharge. Penetrating the surrounding structures, great deformity of the face often results. If growth occurs in an upward and backward direction, tinnitus, deafness, and severe pain are usually present, while death may occur from final involvement of the brain in the disease.

Prognosis.—In children the growth ordinarily occurs so rapidly that an early fatal issue is to be expected, while in adults a slower growth makes early and complete evulsion practicable. The tumor will, however, return with increased malignancy if imperfectly removed.

Treatment.—Early and complete removal of the growth, of course, presents the only chance of recovery. Palliative treatment consists in the use of detergent washes and anodyne applications. A 4 per cent. solution of the muriate of cocain may be applied on absorbent cotton to relieve pain and Formula 59 or 60 applied with the powder-blower for the same purpose and also as a disinfectant. Complete excision of the upper jaw on the affected side is necessary when the growth has attained any size, but even after the most complete operation relapses are the rule rather than the exception. In many cases the use of the *x*-ray at least retards the progress of the disease.

Nasal Carcinoma.—Carcinoma of the nose is of rare occurrence as a primary affection, but may invade the nasal cavities from surrounding parts. It is usually of the epitheliomatous or encephaloid type.

Treatment.—Early and complete removal of the affected

structures furnishes the only chance of a cure. Palliative treatment consists in cleanliness, nutrients, and the application of the *x*-ray to retard growth.

DISEASES OF THE NASAL SEPTUM

Deviation.—Normally, the septum is vertical, but after the seventh year deviations generally toward the left are somewhat frequent. Such deviations from the vertical only are considered pathologic when they interfere decidedly with nasal respiration or, by pressure upon the middle or inferior turbinated body, cause pain or nasal reflexes.

Etiology.—Traumatism is by far the most common cause of the *pathologic deviations*, the most frequent traumatism being a dislocation of the triangular cartilage and the anterior portion of the vomer from each other and their attachment to the nasal crests of the superior maxillaries. Under such circumstances the deviation is of the so-called angular variety, because the dislocated horizontal edge of the septum projects into the obstructed nares as a sharp edge or ridge running back as far as the dislocation extends. The dislocation rarely or never involves the whole septum, because the posterior portion of the septum is defended from the effects of traumatism by its bony lateral walls. Rarely is more than the anterior third of the septum involved in a deviation, and it is therefore more exact to speak of a deflected area of a septum rather than a deviated septum.

Between the edges of the dislocated bones and cartilage "provisional callus" is thrown out, which finally unites the separated edges with a firm bony or cartilaginous union, usually thicker than the normal septum, and hence the so-called "hypertrophied angle" of a septal deviation. It will be seen that after the organization of the "provisional callus" the septum has notably increased in size, is redundant and too large to occupy a vertical position within the nose.

It will be observed that a partial dislocation of the vomer from the nasal crests of the superior maxillaries necessitates a bending of the triangular cartilage toward the obstructed naris, and either a drawing downward of the tip

of the nose, a fracture of the cartilage, or a separation of the cartilage from its articulation with the vomer, and in extreme cases also partly from its articulation with the perpendicular plate of the ethmoid. It is probable that in the majority of cases the latter takes place, as in most traumatic or angular deviations there is usually considerable thickening at the posterior articulation of the triangular cartilage with the bones of the septum, the result of the deposit of provisional callus. It follows that in all deviations of the septum there is redundancy of the deviated area, both in the vertical and horizontal direction. According to the extent posteriorly of the dislocation of the septum from the superior maxillary may the deviation be described as vertical or horizontal. In comparatively rare cases a vertical deviation of the septum will involve so little of the septum anteroposteriorly as scarcely to admit the blunt end of a lead-pencil into the deflected area at the base of the septum. Such a deflection probably would result from a very rapid and violent bending of the tip of the nose to one side.

Probably the larger number of deviations, so slight as not to be considered pathologic, are the result of a faulty development of the bones of the face. It is stated that adenoids and other causes of defective nasal respiration cause a high arching of the palate, and the septum, crushed between this abnormally high arch of the palate and the nasal bones, is bowed, as it were, out of the median position. During the development of the bony parts of the septum the floor of the nostril is not rigid, for the sutures between the maxilla, palate, and intermaxilla are wide and are filled in with soft tissue, on which the septum rests. Should ossification of this soft tissue occur too soon, it is stated that it would materially interfere with the growth of the septum, causing it to be deflected or crumpled.

As a matter of fact, a comparatively large proportion of deflected septa are encountered, associated with a high arch of the palate, in which the deviation is pathologic and evidently not traumatic. Such deviations are curvilinear instead of angular, sometimes S shaped, and there is usually little or no thickening of the sutural lines. However, they rarely if ever involve the whole septum.

Asymmetric development of the two sides of the face, if it involved the nasal septum, would result in a bowing or deviation of the septum toward the larger side of the face, because the concave surface of a deviated septum is, of course, smaller than the convex surface.

Pathology.—Septal deviations occur in almost endless variety. A simple classification is physiologic and pathologic, angular, with or without hypertrophied tissue at the angle, round and S shaped, vertical and horizontal. The deviation usually involves little more than the anterior third of the septum, and almost never if ever the entire septum. In almost all cases of sharp, angular deviations hypertrophic changes occur at the apex of the angle, the narrowed nostril being still more obstructed by the bony ridge.

Symptoms.—There is sometimes some deformity of the external nose, the tip of the nose being turned to one side or the bridge flattened. The degree of obstruction in the narrowed nostril is in proportion to the deviation of the septum and may amount to occlusion. Usually in such cases there is complete obstruction to inspiration from a valve-like action of the ala of the affected side, while expiration is somewhat free and unimpeded as the result of the blowing outward of the ala by the expired air. Nasopharyngeal catarrh is usually present and is the direct result of the deviation. It will be observed that during inspiration a partial vacuum occurs posterior to the obstruction and consequent vacuum congestion; that is, the decreased atmospheric pressure behind the obstruction engorges the blood-vessels of the mucous membrane by a species of suction. The vacuum congestion and consequent catarrhal inflammation frequently extend backward to the nasopharynx. Vacuum congestion also occurs within the dilated portion of the unobstructed nostril, and when chronic catarrh of the middle ear results, it is often the ear upon the side of the unobstructed nostril that first is affected. It might be objected to this mechanical theory of the causation of vacuum congestion back of a deflected area upon the septum that any partial vacuum resulting during inspiration would be counteracted by increased pressure during expiration. That this is not the case is due

to the fact that expiration is more deliberate and passive than inspiration and the valve-like action of the ala referred to above.

The amount of obstruction to nasal respiration resulting from a deflected septum is precisely the same as if the obstruction resulted from an exostosis. When the obstruction is complete for inspiration the individual loses one-half his nasal breathing space; for what breathing space is lost in one nostril is not compensated for by increased breathing space in the other, because the unobstructed nostril is not

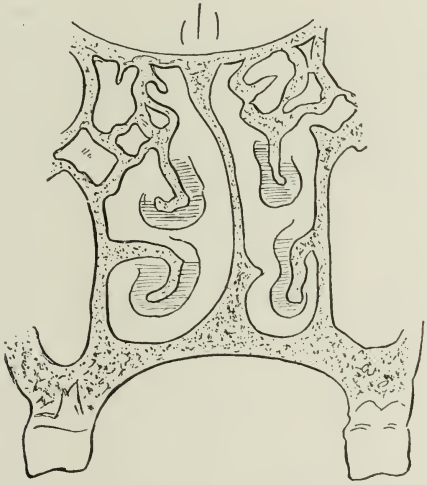


FIG. 69.—Deviation of the septum and adjustment of the turbinated bodies (Coolidge).

larger, either anterior or posterior to the obstruction, and hence will not transmit more air than if the septum were not deflected.

In the dilated area of the unobstructed nostril the inferior and sometimes the middle turbinated bodies are frequently hypertrophied, probably as the result of the increased blood supply resulting from the decreased atmospheric pressure in the dilated area referred to above. As the result of such hypertrophy the breathing space within the dilated area may be reduced to normal limits (Fig. 69). In

the obstructed nostril the turbinated body may become atrophied from the pressure of the deflected septum. Should the deflection be so located as to cause pressure upon the middle turbinated body, pain and nasal reflexes are usually present. Fortunately, great deviation of the septum in this region is comparatively rare, and if present without obstruction to respiration the removal of a portion of the middle turbinal will prove an easier and more satisfactory operation than an attempt to restore the septum to a vertical position. Pressure symptoms may also be relieved in some cases by the removal of a portion of the septum by the saw.

In some cases when the deflection is so slight as scarcely to be considered pathologic, erosions occur upon the septum. The inspissated secretions of such erosions being in a hollow of the septum, and hence not in the direct breath-current, are usually removed by the finger-tip or by violently blowing the nose. Usually some of the septal tissue is removed with the accumulation and hemorrhage results. The condition is a common cause of recurrent nasal hemorrhage. When such accumulations are removed by the finger-nail the erosion usually becomes deeper and deeper, until the individual literally picks a hole through his septum.

The *two factors interfering with the success of operations for the correction of deviation of the nasal septum* are redundancy and resiliency. The septum is too large to occupy a vertical position within the nose, and hence any operation, to be successful, must provide for the redundancy of the septum, both in the horizontal and vertical direction. The simplest method would seem to be a rectangular crucial incision through the center of the deviation. After such an incision, if the deviated area of the septum is brought into the median position, the edges of the four triangular flaps overlap, and thus the redundancy of the septum in both the horizontal and vertical directions is provided for. Redundancy of the septum is equally well provided for by multiple incisions through the septum, crossing each other at a common center, and by L, ⊥, U, and H incisions through the septum. This is far from being true as regards the resiliency of the

septum. Septal resiliency is best counteracted by means of a long, narrow, quadrilateral flap or by submucous complete removal of the cartilage and bone from the deviated area.

It must not be supposed that because the deviated area of a septum is too large to be crowded into a position on a plane every point of which is equidistant from the lateral walls of the nose that, therefore, the tissues of the deviated septum are subjected to tension which, if released, would result in the deviated area of the septum assuming a normal vertical position as the result of its resiliency. On the contrary, if a deviated septum be dissected out from the nose, its deviated area does not change its shape, and if pressed into a position parallel to the rest of the septum, it immediately springs back into its original deflected position as soon as the pressure is released. It must not be imagined, as stated by some authors, that the resiliency of the septum is *destroyed* by incisions of any shape, mentioned above, as the resulting flaps when bent all tend to spring back into their former position.

FIG. 70.—Vertical, transverse section through the anterior portion of the nose; angular deviation of the septum, with hypertrophy of the tissues at the angle of the deviation. The dotted line indicates the direction of the saw-cut for the removal of the obstruction.

Resiliency is an inherent quality of both the bony and cartilaginous septum. However, if the bony portion be fractured, the broken bone remains in the position in which it is placed and the resiliency at the line of fracture is destroyed. The cartilage of the septum, on the other hand, is not readily fractured, but when bent at a right angle or more, its resiliency is greatly lessened for a considerable time.

Operations for Correction of Deviation of the Nasal Septum.—*Bosworth's Operation.*—The simplest operation is that introduced by Bosworth (Fig. 70)—the removal of the hypertrophied angle of the deviation with a saw. The operation is successful to the extent that it secures increased breathing space in the obstructed nostril, and the septum

probably is brought more nearly into the median line as the result of the contraction of the resulting scar.

Ingal's Operation.—Fletcher Ingals of Chicago makes an oblique incision through the membrane of the convex portion of the prominence. He then detaches the membrane a certain distance on each side of the cut from the underlying cartilage, exposing the latter. A triangular piece is then cut out, the base of the triangle being at the floor of the nose. Care should be taken to detach the cut piece from the lining membrane of the other cavity *without tearing or cutting through it.* The first incision is closed by stitches and the cartilage is pressed into line and supported by means of tampons.

Sajous' Operation.—An operation formerly frequently performed in Philadelphia is described by Sajous as follows: "The least difficult operation and one which has always given me great satisfaction, in simple cartilaginous deflections, is an incision through the protuberance, following its long axis. A smart hemorrhage occurs as soon as the incision is made, but it soon ceases. The end of the finger being introduced into the nostril, the septum is forcibly pushed beyond the center and maintained there by packing the previously obstructed nostril with carbolized oakum. The cut edges of the cartilage override each other and after a couple of weeks are firmly united." In this operation the lower portion of the septum is practically immovable by the finger, and hence the upper portion of the septum when brought into the median line hooks over the lower because of its redundancy, and to a certain extent is prevented from returning to its former deflected position. However, Sajous does not depend upon this support, but uses a pad of oakum. Seiler described practically the same operation, but uses as a means of support a steel pin, which, while the finger is still in the nose, is thrust through the skin at the lower extremity of the nasal bones and then downward between the finger and the septum until its point is imbedded in the portion of the septum below the horizontal incision. After the finger is withdrawn from the nose, a few blows from a lead mallet serves to drive the pin firmly into the superior maxillary bones at their suture.

At the end of about ten days the steel pin becomes loose and useless as a means of support and has to be withdrawn.

Watson's Operation.—Watson describes his operation as follows: "I make an incision, which may be called a bevelled incision. The edge of the knife is directed upward and toward the opposite side, and carried through the cartilage, but not the mucous membrane of the opposite side. The incision is made just at the crest of the deviation. Any vertical deviation is cut out, as before described (Ingals' Operation). The upper portion is then pressed over toward the other side, where it hooks itself on the lower, and is thus held in place."

Watson's operation is a combination of the methods of Ingals and Sajous, and no detail of Watson's operation is original except, perhaps, that he more carefully bevelled his horizontal incision through the apex of the deviation. When the apex of the deviation is not hypertrophied, it would seem that in so thin a structure as the septum it is impossible to obtain any appreciable *bevel*, and as bevelling does not increase the resistance to the septum assuming its former abnormal position, it is difficult to understand its importance. The preservation of the mucous membrane on the concave surface prevents the flap being bent at a sufficiently acute angle to destroy its resiliency. In the older operations of Sajous and Seiler this same hooking of the upper fragment over the lower was found not sufficient to retain the parts in position, probably because of pressure-necrosis; and support for a tediously long period by pins or plugs was found insufficient to secure invariably good results.

Gleason's Operation.—The writer's method of operating for deflection of nasal septum is as follows: A U-shaped incision (Fig. 71) is made around the deviated area (*a*), which then becomes a quadrilateral flap, covering a hole in the septum; a sort of trap-door with a spring hinge holding it in a deviated position. This quadrilateral flap is then, with the finger-tip, pushed through the hole in the septum, which it covers, and its neck (*c*) is bent at the same time at a right angle. If the deviation area is of the horizontal

type and extends far back along the septum, the neck of the quadrilateral flap will contain a considerable amount of bone. When the neck of the flap is bent at a right angle this bone will be fractured with a snap, often audible at a considerable distance. The resiliency of the bony portion of the flap is then *completely* destroyed, because fractured bone remains in the position in which it is placed. As a matter of fact it, to a certain extent, acts as a splint to retain the cartilaginous portion in a vertical plane, which it is usually impossible to fracture even by bending to a right angle.

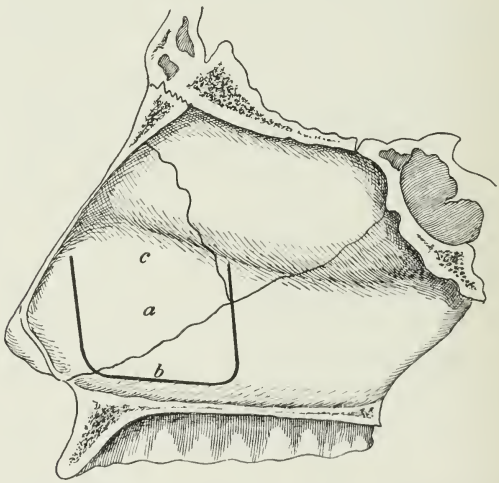


FIG. 71.—Diagram of author's operation. The traumatism originally causing the deflection is practically reproduced by converting the deflected area of the septum into a quadrilateral flap: *a*, Deviated area of the septum, surrounded by a U-shaped incision; *c*, neck or base of the resulting quadrilateral flap; *b*, its inferior edge.

However, by the thorough bending of the cartilage the resiliency of the flap is diminished, for the time being, to the extent that it hangs without support in the vertical position, its redundant edge overlapping, without pressure, the edge of the hole in the septum, in front, below, and behind.

The quadrilateral shape of the flap has much to do with its remaining in a vertical plane. In any cartilaginous septal flap the resiliency tending to reproduce the original

deformity is proportionate to the width of the base (*c*) of the flap. In the triangular flaps used by Asch, Roberts, Watson, and others the width of the base of the flap rapidly increases with the size of the flap. In the quadrilateral flap the base of the flap (Fig. 71, *c*) is always of the same width as its edge (*b*), and consequently, because of constantly increasing leverage proportionate to the length of the flap, in long, narrow, cartilaginous flaps, but very little support at its lower edge (*b*) is required to maintain such a flap in the vertical plane. This very important factor in the success of operations for the correction of septal deflections may be demonstrated by cutting flaps of various shapes in the side of a rubber ball, the resiliency of which may be compared to that of the cartilaginous septum. The main idea in devising this operation was to provide a better method of overcoming the resiliency of the septum than those then in vogue, and all other considerations were sacrificed to this idea. In most operations it is not septal *redundancy*, but the neglect or the impossibility of providing for septal *resiliency* that causes failure. The resiliency of the septum is exerted for months upon septal flaps after apparent healing, and often gradually reproduces, in part at least, the original deviation. It is impossible to judge of the success of an operation for septal deviation until at least six months have elapsed. Therefore it is best in most instances to slightly overcorrect the deviation.

The technic of the writer's operation is as follows: Both sides of the septum are anesthetized by packing the nose with pledgets of absorbent cotton saturated with a 3 to 4 per cent. solution of cocain. This is allowed to remain in contact with the parts for one-half to one hour in order that this weak solution of cocain may penetrate deeply into the tissues. The nostrils are sprayed with a 1 : 1000 solution of adrenalin. The line of incision is then painted by means of a cotton-tipped probe with a 10 per cent. solution of cocain in order to produce profound superficial anesthesia.

The field of operation is brought into view by means of the self-retaining speculum (Fig. 22), and a straight Sajous saw is introduced into the obstructed nostril, close to and

parallel to the floor of the nose. The septum is sawed transversely until the saw has obtained a firm hold upon the tissues; the direction of the sawing is then somewhat rapidly changed until it becomes nearly vertical, the saw meanwhile being carefully maintained in a position *exactly parallel* to the septum. A gush of blood from the unobstructed nostril indicates that the sawing has extended through the septum. The saw is now partly withdrawn and its tip pushed through the cut into the unobstructed nostril. The anterior crus of the U-shaped incision is made by sawing upward with the tip of the saw. The posterior of crus is most quickly made by introducing a probe-pointed, double-edged knife, curved on the flat (Fig. 89), from the left nostril through the saw-cut. The index-finger-tip is then introduced into the right nostril. Finger and knife together reach the posterior limit of the deviated area, and the posterior crus of the U-shaped incision is quickly and easily made.

If the deviation is toward the right nostril the operator wets his left forefinger in sterile water, while if the deviation is toward the patient's left nostril the right forefinger, after being wetted, is introduced into the obstructed nostril, pushing and, if necessary, lifting up the deflected area until it has been thrust through the hole in the septum which it covers. The operator's forefinger-tip is then carried up along the anterior and posterior crura of the U incision to make sure that the flap has completely cleared them; the finger-tip is then thrust through the hole in the septum beneath the quadrilateral flap until the lateral wall of the nose in the unobstructed nares is touched. The finger is then pressed upward until the flap is bent at a right angle and any bone in the neck (Fig. 71, *c*) of the flap breaks with an audible snap. This is of the utmost importance, and in horizontal deflections the success of the operation depends *entirely* upon the bending of the flap being thoroughly done. In vertical deflections too narrow to permit of the forefinger being used, the little finger should be employed.

After the thorough bending of the flap it should hang in the formerly unobstructed naris without resiliency (Fig. 73); and either Allen's tube or the writer's modification of

the same should be dropped into the formerly obstructed nostril. Should any impediment to its free entrance into the nostril be encountered, it is probable that the U-shaped incision has been improperly made and has passed *through* instead of *around* some portion of the deviated area. This is usually the posterior portion of the deflected area, the posterior crus of the U-shaped incision being made too far forward. An effort should be made to bring this deflected posterior edge of the incision into line with the finger-tip in order to admit of the easy introduction of the tube, and, failing in this, the end of the tube should be compressed by the fingers in such a manner as to permit of its easily being

FIG. 72.—Vertical, transverse section through the anterior part of the nose; angular deviation of the septum without hypertrophy of the tissues at the angle of the deviation. The dotted line indicates the direction of the saw-cut for forming the tongue-shaped flap covering the button-hole in the septum.

FIG. 73.—Vertical, transverse section through the anterior portion of the nose, showing position of the septum after the tongue-shaped flap has been thrust through the button-hole in the septum. After healing has occurred, the parts at *B* are sometimes abnormally thick; but redundant tissue can readily be removed with the saw, Ordinarily it disappears spontaneously.

passed beyond the obstruction. The tube should always fit *loosely*. Any great amount of pressure exerted by the tube becomes well-nigh intolerable within twenty-four hours. The tube serves to control the usually trifling hemorrhage. It is worn over night and the next day it is decided if its support is longer necessary. In rather more than 80 per cent. of cases of deviation of the nasal septum operated upon by the method described above no support whatever was necessary.

The after-treatment consists in the patient presenting himself at the surgeon's office daily, in the meantime

attending to his usual avocation if not too laborious. At each daily visit the parts are inspected and, if necessary, cleansed. At first the overlapping of the edges of the flaps resulting from its redundancy will appear excessive because of the swelling of the parts; within a week or two this swelling will have disappeared and also, apparently, much of the redundancy, because in traumatic cases the redundancy is newly formed tissue, "provisional callus," and hence is readily absorbed. At any time any redundant thickening can readily be removed, but unless the obstruction is so large in the formerly unobstructed nostril as to produce a decided impediment to respiration it is best to defer "trimming up" the redundant septal thickening until several months have elapsed after the operation, and the redundancy has thoroughly performed its function as a splint to prevent the quadrilateral flap of deflected area returning through the septum to its former deviated position. Rarely is any "trimming up" required.

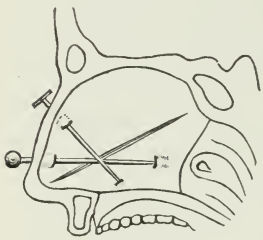


FIG. 74.—Pins inserted for deviation of septum in Roberts' method of operation (Park).

Roberts' Operation.—Roberts makes a long incision, oblique or horizontal, according to requirements, through the septum from back to front through the line of deviation or projection with a knife, and with a chisel through the bony septum if it be deviated. A pin is then thrust through the septum above and in front of the incision. By manipulation of the pin and finger introduced into the obstructed naris the upper or movable portion of the septum above the cut is brought into the middle line, and held in position by forcing the pin forward through the tissues in such a manner that it crosses the incision. A second pin is sometimes introduced through the skin at the lower portion of the nasal bone parallel to the septum, in order to assist in retaining the parts in position. If the deflection of the septum is a general rather than an abrupt one, Roberts weakens the septum after the primary incision by multiple incisions with Steele's stellate punch, "because the opera-

tion will be *useless* unless the incisions are very free, so as to take away all resiliency of the cartilage."

Asch's Operation.—Until recently by far the most popular operation for deflection of the nasal septum, at least in America, is that devised by Morris I. Asch, of New York, described by him as follows: "It occurred to me that

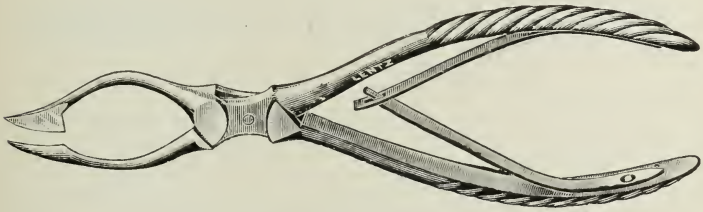


FIG. 75.—Asch's scissors.

the vital point to attain in operating for this condition was to destroy the *resiliency* of the cartilage in such a way that when it should be forced back into its proper position, and held so for a proper length of time, the result would be a straightened septum without any loss of tissue and the re-establishment of the respiratory function of the affected nostril.

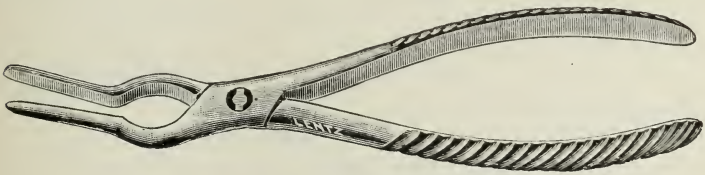


FIG. 76.—Asch's compressing forceps.

"The instruments required for the operation consist of a cutting forceps (Fig. 75), compressing forceps (Fig. 76), blunt and sharp separators (Figs. 77 and 78), to break up any adhesions which may exist between the convex portion of the deviated septum and the inferior turbinated body, and tubular nasal splints made of hard rubber. The cutting forceps or scissors are made in two sizes. They are powerful instruments, curving outward from the point of junction and meeting again in front, one blade is blunt and narrow

for introduction into the stenosed nostril, while the other is sharp with a triangular blade. Other scissors (Fig. 79) are made with the blades bent at a right angle, for use in deviations requiring an incision running downward. The compressing forceps used for straightening up the septum after

FIG. 77.—Asch's separator, with blunt edge.

incision are of two sizes with long and short blades respectively. The splints (Fig. 80) are curved hollow tubes made of vulcanite with perforations to prevent them slipping. An atomizer containing Dobell's solution is kept in a bowl of

FIG. 78.—Asch's separator, with sharp edge.

ice to check any hemorrhage. The operation is performed under complete anesthesia of chloroform, ether, or Schleich's mixture, which has given good results in these cases. All the instruments are to be carefully sterilized and the nose

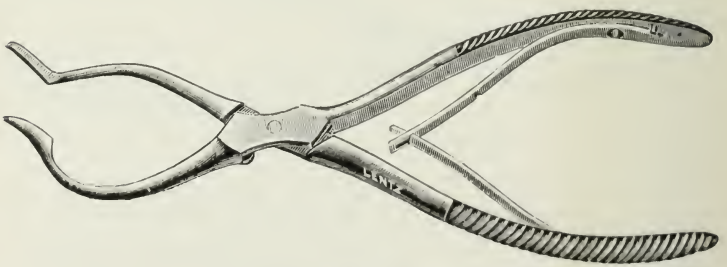


FIG. 79.—Asch's scissors.

washed out with an antiseptic spray before operating. The head of the patient being drawn backward over the edge of the table, so that blood will not enter the larynx, and the nostril illuminated either by direct or artificial light; the

blunt separator is introduced into the deviated side, so as to break up any adhesions that may exist and to ascertain the presence of any bony obstruction posteriorly, should such be found, the sharp separator can be used or an ordinary small bone chisel. The scissors are now introduced parallel to the floor of the nose, the sharp blade being in the concavity and the blunt one over the line of greatest convexity of the deviation; it is important that the blades should be at right angle to the septum at the place of incision, otherwise the blades may override and the scissors fail to cut through. The blades being firmly closed, the sharp one cuts through the cartilage into the opposite side with a distinct snap. The scissors are then opened and completely withdrawn. They are immediately reintroduced in the same manner as before, with the blades pointing this time in a vertical direction, crossing the line of the first incision as near as possible at right angles

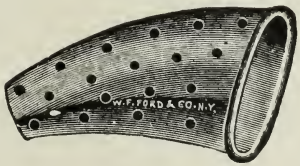


FIG. 80.—Mayer's tube.

and at its center; the scissors are now closed and the second incision made, after which the scissors are opened and withdrawn. We have thus four segments as the result of the crucial incision. The operator now introduces his finger into the stenosed nostril and forcibly pushes the segments into the concavity of the opposite side, effectually breaking them at their base. The finger should be pushed through. This part of the procedure must be done thoroughly and carefully, for on it depends the success of the operation. If the segments are thoroughly broken at their bases the resiliency of the cartilage is destroyed and the deviation cannot recur. The compressing forceps are now introduced, one blade in each nostril, and the septum compressed in order to straighten it still further and to force the broken segments to more completely override each other. The iced Dobell's solution in the atomizer is now sprayed into

the nostrils in order to check the bleeding, and the sterilized tubes introduced, a snugly fitting one into the side previously stenosed and a smaller one in the opposite. These serve to prevent hemorrhage and to hold the septum in its new position. This completes the operation, which, in experienced hands, should not occupy over five minutes. The patient is now placed in bed, iced cloths applied externally, and a cold antiseptic solution sprayed into the nostrils every half-hour. Twenty-four hours after operation the tube in the non-stenosed side is removed and not replaced, the spray and compresses being continued. Twenty-four hours later the tube in the opposite side is removed, thoroughly cleansed and sterilized, the nose is sprayed and cleansed and the tube replaced, cocain being used if necessary. The same tube should be reinserted unless it proves too large for comfort, in which case the next smaller size can be used. This tube must be taken out and cleansed every day by the surgeon while the patient remains in bed, which he should do for at least four days. At the end of this time the nostril is less sensitive and the patient should be able to extract and reintroduce the tube himself. This is to be done every day for four weeks, coming once a week to the surgeon for observation, and at the end of the time the tube is permanently withdrawn, the septum having now become sufficiently solid to remain in its new position without support. It sometimes happens that the lower segment remains thickened after the tube has been withdrawn and projects into the nasal cavity; this can easily be rectified by the electrotrephine or galvanic cautery, though if left to itself the thickening will eventually disappear."

Kyle's Operation.—Kyle, of Philadelphia, makes two horizontal parallel incisions through the deflected area by means of Fetterolf's triangular file (Fig. 81), not involving the mucous membrane of the convex side of the septum, and brings the enclosed area into the median line by means of finger or forceps. Fetterolf has modified Kyle's operation by the use of triangular files (Figs. 81, 82). The operator's finger is inserted into the unobstructed nostril and parallel incisions made with the sharp-edged file (Fig. 81) on the convex surface of the septum, the finger of the

operator readily detecting when the cartilage has been cut through to the mucous membrane. If desirable more cartilage can be removed by means of a file truncated on its edge (Fig. 82), in order to avoid wounding the mucous membrane of the convex side of the septum. Two—sometimes three—parallel incisions are made, one just below, one through the center, and one just above the deviation. Sufficient cartilage is removed to completely destroy the resiliency of the septum.

FIG. 81.—Fetterolf's sharp-edged triangular file.

Roe's Operation.—Roe, of Rochester, breaks the bony portion of the septal deviation by means of specially constructed forceps of several sizes, the male blades of which fit into a fenestrum in the female blade. By means of these forceps the bone is not merely bent, but is actually fractured, and the resiliency of that portion of the septum destroyed.

"*Window resection*" *of the deviated area*, advocated first by Ingals (see Ingals' Operation) and later by Krieg, has many advocates. Killian removes the cartilage and bone

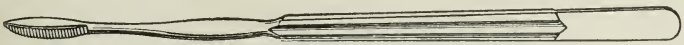


FIG. 82.—Fetterolf's truncate-edged triangular file.

of the entire deviated area, preserving the mucous membrane of both sides of the septum. The technic of the operation and the instruments have been greatly improved by Ballenger, who describes his method as follows:

"The technic of the operation," according to Ballenger, "is after the Menzel-Hajek method with the exception of the removal of the cartilage. In the Menzel-Hajek operation the cartilage is removed piece by piece with punch forceps; whereas, by my method it is removed in one piece with one cut of the swivel knife. The time required for the removal of the cartilage after the mucoperichondrium has been elevated need consume but a few seconds; whereas, by

the Menzel-Hajek method it takes from a few to several minutes for its removal. Using a special knife (Fig. 83) I make a curved incision in the septal mucosa of about 1 inch in length, beginning near the floor of the nose and curving forward and upward, as high as I can, through the vestibule of the nose and about $\frac{1}{4}$ inch posterior to the

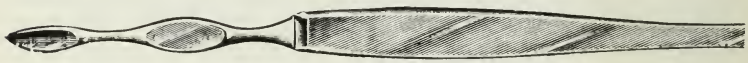


FIG. 83.—Ballenger's septum knife.

anterior margin of the cartilage. I have not found it necessary or expedient to make the incision on the convex side of the septum, as is commonly recommended; but I find it advisable to make it on the left side of the septum regardless of whether this is the convex or the concave surface. I do this because it is convenient to use the knife

FIG. 84.—Hajek's semisharp elevator.

with the right hand while the forefinger of the left is inserted into the right nostril. Having made the curvilinear incision through the mucoperichondrium on the left side of the septum, I next resort to the semisharp elevator of Hajek (Fig. 84) to elevate the anterior portion of the mucoperichondrium from the septum, after which Hajek's blunt

FIG. 85.—Hajek's blunt elevator.

elevator (Fig. 85) should be used. The semisharp elevator should only be used to start the elevation, as to continue its use might result in a perforation of the mucous membrane, whereas the dull elevator can be used with great rapidity without danger of perforation.

" The next step in the operation consists in carrying the anterior curvilinear incision of the mucosa through the septal cartilage to the perichondrium of the opposite side. This is done with a small bistoury (see Fig. 83), the forefinger of the left hand being inserted into the right nostril to detect when the cartilage is completely incised. After one has had considerable experience in the incision of the cartilage with a knife he may not find it necessary to introduce the finger into the opposite nostril, as he can readily appreciate when he is through it by the sense of touch or by the resistance felt with the hand holding the knife. The semisharp elevator of Hajek may be used to perforate the cartilaginous septum along the line of the curvilinear incision by rubbing it to and fro in the mucoperichondrial incision, the index-finger of the left hand being inserted in the right nostril to exert counter-pressure and to detect by the tactile sense when it is completely broken through.

FIG. 86.—Ballenger's swivel knife.

" The incision through the cartilage having been made by either of the above methods, the semisharp elevator should be inserted through it with the flat side turned so as to lie against the right side of cartilaginous septum, and while in this position it should be moved up and down and insinuated between the cartilage and the mucoperichondrium of the right side. To facilitate this procedure the tip of the nose should be turned toward the patient's right side, thus exposing the curvilinear incision through the mucosa and cartilage, and making it possible to introduce the semisharp elevator on a plane parallel with the septum. After this side is started, the dull elevator is used to complete the separation. Care should be taken to lift the

mucoperichondrium from the entire deflected area, as to fail to do so makes it impossible to remove a sufficient amount of the cartilage.

"The mucoperichondrium on both sides of the septum now being elevated, the prongs of the swivel fork are introduced through the curvilinear incision, one prong being on the right side of the septum and the other on the left. The instrument should now be directed backward parallel with the floor of the nose until the posterior limit of the cartilage is reached, when it should be directed upward and forward, following the outline of the anterior end of the perpendicular plate of the ethmoid to the bridge of the nose, when it should be pulled downward parallel with the cavity, the triangular blade resting upon the concavity of the ridge of the nose to the upper extremity of the curvilinear incision. In this way almost the entire cartilaginous septum except the anterior tip, which is left to support the tip of the nose, is removed. The excised cartilage should now be seized with a pair of dressing-forceps and removed through the curvilinear incision. The cartilage thus removed is usually roughly triangular in shape, the acute point of which represents the posterior end of the cartilage."

For the removal of a portion of the bony septum Freer's modification of Grünwald's punch-forceps may be used. With the instrument, according to Freer, bone $\frac{1}{8}$ inch thick can be bitten in two. With this instrument the bony septum may be removed piece by piece. After removal of the cartilage the nasal cavity and wound are cleared of all débris. The mucous membrane is brought into as near normal apposition as possible and covered with gauze previously dipped in albolene. Over this a very light packing of bichlorid gauze is placed. On the opposite side of the nose a light packing of gauze may be placed as a support to the membranous septum. The dressing on both sides may be dispensed with the following day. The nose should be cleansed twice daily with Dobell's solution until recovery is complete.

Lee Maiden Hurd says of the operation (Manhattan Eye, Ear, and Throat Hospital *Reports*, March, 1906): "Inasmuch as the operation has come to stay, it will in time

probably supplant the crushing operations of Asch, Gleason, Roe, and others entirely. However, it is a much more difficult operation to master thoroughly than the above mentioned, and in consequence of these technical difficulties it may not be as universally employed for some time as its merits justify."

In the older operations solid plugs of vulcanite or ivory were sometimes used. Sajous employed a plug of oakum, and pledgets of iodoform gauze or absorbent cotton are sometimes employed at the present time. Roberts employed steel pins to hold the septum in position after operating (Fig. 74). The pin had a square head. Seiler used an ordinary darning needle; Gibbs, a pin with a pear-shaped head; and Watson, a pin with a spear-shaped point, the other end bent into a ring and protected by a piece of thin rubber, through which the pin was thrust before being used.

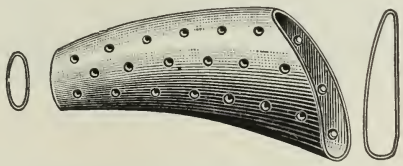


FIG. 87.—Kyle's malleable nasal tube.

Steel pins may be allowed to remain in the tissues for about ten days; after that time they become so loose that they have to be removed. They cause a certain amount of sloughing of the cartilage, which aids in reducing its resiliency.

Asch and Meyer employ vulcanite tubes (Fig. 80). Berens, of New York, used a hollow olive-shaped splint of cork, varnished with iodoform collodion. Kyle employs the tube shown in Fig. 87, made of soft malleable metal, so that it readily can be bent or cut into a shape suitable for the nasal condition present. Harrison Allen devised a brass silver-plated tube, which differs from the other tubes inasmuch as it is prevented from slipping from the nose by the upper portion of its distal extremity, which rests in the hollow space at the tip of the nose. The writer has slightly modified the shape of this tube, and had it made in

three sizes, of the same soft malleable metal employed in the Kyle tube. It readily can be cut with a knife or scissors or pressed by the fingers or the handle of an instrument to meet any unusual nasal condition present, should such modification of its shape be necessary in any particular case.

Congenital Occlusion of the Nares.—Congenital occlusion of either the anterior or posterior nares, usually unilateral, is a somewhat rare condition. When the posterior nares are occluded generally it is the result of a bony outgrowth from the floor of the nose. The anterior naris may be occluded as the result of faulty development or adhesions during embryonic life.

FIG. 88.—Gleason's nasal tubes.

Symptoms.—The symptoms are those of occlusion from any other cause. When the occlusion is posterior, there is a discharge of mucus from the nose upon the lip and the patient is unable to cleanse the nostril by blowing the nose. Aural symptoms are sometimes present when the obstruction is anterior.

Diagnosis is made by inspection. Anterior obstructions are readily seen, and those which are posterior may be observed in the rhinoscopic mirror. A rough estimate of the thickness of a posterior obstruction can be made with an Allen's probe, the end of which is wrapped with cotton and saturated with a 4 per cent. solution of cocain. This is introduced into the obstructed naris until the obstruction is reached, and the distance compared with that to the posterior edge of the septum on the unobstructed side.

Anterior obstructions are usually thin and web-like. Posterior obstructions usually have a thickness of not over $\frac{1}{4}$ inch.

Treatment.—It is comparatively easy to break down nasal obstructions, either anteriorly or posteriorly; but as they almost invariably recur unless prevented from doing so by a somewhat tedious after-treatment, the wisdom of operating in young children unless very docile is worth considering. When only one side is affected and causes but little inconvenience, the operation in young children should be postponed until the child has arrived at an age to appreciate the advantage to be derived from the after-treatment.

Anterior obstructions are excised with a knife or scissors and a pewter tube (Fig. 88) of suitable size and shape inserted. This is removed and cleansed daily after the operation until the parts have completely cicatrized.

Posterior bony obstructions are removed with the guarded electric drill or burr (Fig. 63), either under ether or, as the operation is not very painful, under cocain anesthesia. If ether is employed the tip of the forefinger of the operator's

Fig. 89.—Seiler's septum knife.

left hand is inserted into the posterior naris from the pharynx, to serve as a guide to the parts to be removed by the drill and to prevent injury to the surrounding structures.

The after-treatment consists in daily cleansing the parts and the passage of bougies until cicatrization is complete. However, in spite of every precaution, the posterior naris at the site of the operation frequently becomes again occluded by a thin cicatricial membrane. Should such a membrane form, it possesses but little vitality, and in 2 cases observed by the writer was destroyed by piercing it in two or three places with a small galvanocautery-knife; after which it did not recur.

Dislocation of the Columnar Cartilage.—The so-called columnar cartilage is the inner plate of the lower lateral cartilage of the nose (Fig. 50), a small strip of cartilage lying parallel with the lower border of the septum, the purpose of which is to act as a support to the columna.

Dislocation of the columnar cartilage, as ordinarily seen,

consists of the displacement laterally of the distal extremity of the septum in such a manner as nearly to occlude the affected nostril (Fig. 90).

Treatment.—The mucous membrane should be incised over the most prominent part of the deformity in such a manner as to allow the excision of a sufficient amount of the septal cartilage to restore the patency of the affected nostril. It is not generally necessary to suture the edges of the incision after the excision of the cartilage. No after-treatment is required.

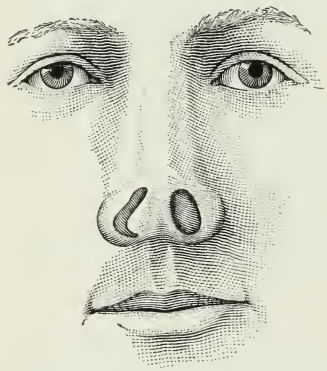


FIG. 90.—Dislocation of the columnar cartilage of the nose into the right nostril (Bosworth).

Hematoma of the septum is an extravasation of blood beneath the mucous membrane of the septum, generally the result of traumatism. It presents itself as a blood-red tumor, sometimes large enough to obstruct nasal respiration.

Prognosis.—The blood may be absorbed, or inflammation may occur and an abscess result.

Treatment.—If the amount of blood is large, an incision should be made to allow it to escape.

Abscess of the Septum.—*Etiology.*—Abscess of the septum may result from traumatism, syphilis, or phlegmonous inflammation of the septum.

Symptoms.—There may be the history of a chill, followed by fever, as in abscess elsewhere. Upon inspection the nose is found to be obstructed by a soft, fluctuating tumor of the septum. Generally the septum is soon perforated, so that the tumor becomes bilateral.

Treatment.—Early evacuation of the pus to prevent extensive destruction of the parts involved in the inflammation and hasten resolution. The incision through the abscess should be sufficiently free to allow of syringing with sublimate solution if deemed necessary, and the patency of the opening should be maintained by the daily passage of a

probe or the introduction of a drain of iodoform gauze. If a sequestrum of cartilage or bone form it should not be removed until completely separated, and extreme care should be exercised to prevent injuring the mucous membrane of both sides of the septum, or a perforation of the septum will be present when the healing process is complete.

Submucous infiltration of the septum is a comparatively frequent accompaniment of chronic rhinitis, consisting of an edematous tumefaction situated on each side of the septum, generally at its posterior portion.

Treatment.—If nasal respiration is obstructed, the masses may be scraped from the septum with the nasal curet or cauterized with the galvanocautery.

Injuries and Deformities of the Bony Framework of the Nose.—By far the most common result of nasal traumatism is dislocation of a portion of the septum from its attachment to the nasal processes of the superior maxillary bones. The dislocation is often overlooked at the time the injury is received because of the profuse hemorrhage. If a surgeon is consulted, his efforts usually are directed to controlling the flow of blood; and often he does not again see his patient for some days or weeks. Then the patient states that he can breathe through one nostril, but not through the other.

Inspection of the nasal cavities shows a bulging area of septum in the obstructed nostril, corresponding to a concavity upon the septum in the opposite nostril. If seen within a week or two of the injury, the parts should be anesthetized by placing pledgets of absorbent cotton saturated with a 4 per cent. solution of cocain. The surgeon, after removing the cotton pledgets, wets with sterile water the forefinger of his right hand if the patient's left nostril is obstructed, or the left forefinger if the obstruction is in the patient's right nostril. With the palmar surface toward the septum and a slight boring motion the surgeon's finger is guided along the floor of the patient's nose. As the finger advances, pressure from the finger-tip readily forces the dislocated septum into a position median to both sides of the nose, after which the tube (Fig. 88) is inserted to act as a splint.

Flattening of the Bridge of the Nose or Saddle-back Nose. —A common result of nasal traumatism is fracture of the nasal bones at the root of the nose. The distal fragments are rotated outward on their long axes and depressed, producing a broadening and flattening of the bridge of the nose. When only one nasal bone is fractured, the tip of the nose is usually turned to one side as the result of dislocation of both lateral upper shield cartilages and the septum.

If the case is seen soon after the injury the displaced nasal bones are brought into position one after the other by means of Adams' forceps (Fig. 91), one blade of which is inserted into the nostril, so that the nasal bone can be grasped between the blades and lifted and turned into the normal position. When both nasal bones are in place they are supported by a splint fashioned from gauze and collodion placed on the outside of the nose. If the septum is deviated at the time of the injury it is brought into the median line and the tube (Fig. 88) inserted into the formerly obstructed nostril.

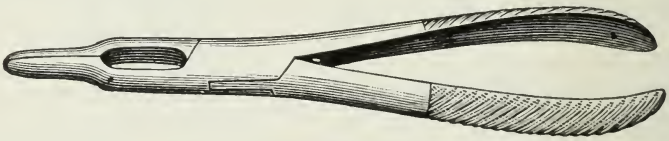


FIG. 91.—Adams' septum forceps.

Old cases of saddle-back nose may be operated on by the following method: To prevent the flow of blood into the pharynx during the operation, the posterior nares are plugged with gauze by the aid of Bellocq's cannula. The patient being etherized, an incision is then made through the skin into the nose close to the septum at the extremity of the nasal bones. One blade of the writer's nasal cutting forceps (Fig. 92) is then thrust into the nose and the other pushed under the skin in such a direction that when the forceps is closed and locked its edges bite into the suture between the nasal bones and septum. When in position the blades of the forceps are locked, and by slightly rotating the instrument backward and forward the suture parts with an audible snap. The forceps are then withdrawn and

the procedure repeated on the other side of the septum. An incision is then made at the anterior-inferior extremity of the nasal bone of one side, and one blade of the forceps introduced into the nose and the other blade beneath the skin. The blades are locked as nearly as possible into the suture between the nasal bones and the nasal processes of the superior maxillary. Backward and forward rotation of the forceps causes the bone to part with a snap, and all resistance to the partial rotation of the forceps ceases. The procedure is repeated on the other side of the nose. The nasal bones are now severed from their attachments except at their base, which also is sometimes fractured by the

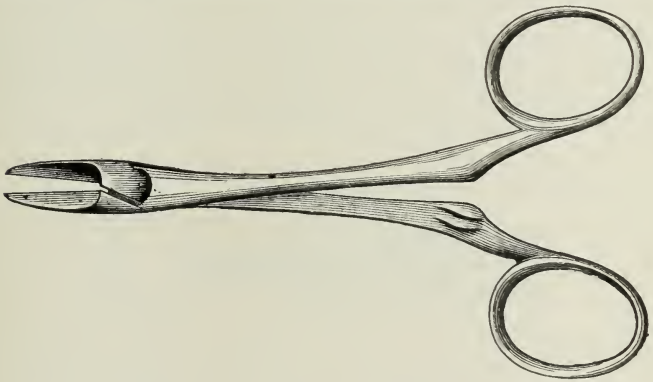


FIG. 92.—Gleason's nasal bone-cutting forceps.

movements of the forceps. One blade of an Adams forceps is now inserted into the naris and the loose nasal bone grasped between the flat blades of the instrument. Ordinarily it is easy to rotate the bone upon its long axis in such a manner as to increase the height of the bridge of the nose, and at the same time the bridge of the nose is made more narrow by pressing the anterior-inferior edge of the nasal bone medianly toward the septum. The same procedure is applied to the opposite nasal bone. Steel pins are now inserted in the space between the nasal bones and the nasal processes of the superior maxillary bones and thrust transversely downward through the septum until their points rest upon the floor of the opposite nostril.

A few blows from a lead mallet serve to firmly fix them in position. The pins are then cut off ¼ inch above the surface of the skin. They cross where they pass through the septum, and hence assume an X shape, the nasal bones being retained somewhat firmly in position by the upper V of the X. The steel pins should be of considerable size, the ordinary darning needles sold in dry-goods' stores answering a very good purpose. In about ten days to two weeks they become loose in the tissues and it may be necessary to remove them, after which the bridge of the nose is supported by a splint fashioned from gauze and collodion, and worn until the bones are firmly united. Should it prove impossible to separate the bones at the suture between the nasal bones and the nasal processes of the superior maxillary subcutaneously by means of the cutting forceps (Fig. 92), an incision is made through the skin down to this suture and the bones separated with a chisel.

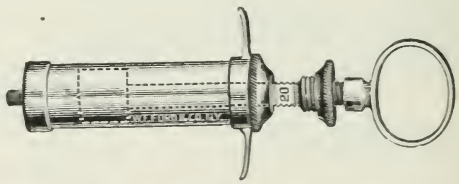


FIG. 93.—Harmon Smith's screw-syringe for the subcutaneous injection of paraffin.

Paraffin Prothesis.—When the bones of the bridge of the nose are destroyed or greatly distorted as the result of syphilis or other cause, satisfactory results follow the injection of paraffin beneath the skin into the cellular tissue of the nose. A special paraffin is prepared by mixing with ordinary paraffin white vaselin until the mixture melts at about 110° F. (Formula 96). This special paraffin is readily injected at ordinary temperatures through a needle but little larger than an ordinary hypodermic needle by means of the screw-syringe (Fig. 93). As the screw is turned the paraffin exudes from the end of the needle in a worm-like thread, readily compressible between the thumb and finger. The paraffin, having been melted, is drawn into the barrel of the syringe, which it completely fills. The end of the

syringe where the needle is screwed on is then closed with a screw-cap to prevent the escape of the paraffin, and the syringe with the paraffin it contains and the needle to be used are dropped into the sterilizer and most carefully sterilized in boiling water. The syringe is then allowed to cool and the needle screwed into place ready to use.

The patient requires no special preparation other than washing the skin of the nose with green soap, alcohol, and, finally, corrosive sublimate solution (1 : 1000).

The end of the needle is inserted near the tip of the nose and thrust through the subcutaneous cellular tissue slightly beyond the deformity. Before beginning the injection the operator should assure himself that the point of the syringe-needle lies in the cellular tissue and hence is freely movable.

The screw of the instrument is slowly turned, and as the paraffin is pushed out through the needle it presses aside the cellular tissue and infiltrates it. The paraffin is molded into shape by the thumb and finger of the operator to the exact shape desired. The syringe-needle is then withdrawn a short distance, and more paraffin thrown into the cellular tissue, which is molded into shape; and so on, until the needle is finally withdrawn from beneath the skin of the nose. Before this is done care should be taken to break the thread of paraffin at the needle's point, so that paraffin will not be drawn *into the skin* as the point of the needle is withdrawn through it. The thread of paraffin is readily broken by grasping the point of the needle through the skin and rotating the instrument immediately before the needle is withdrawn.

Not more than 20 minims of paraffin should be injected at one sitting, in order to avoid injurious pressure and the cutting off of the circulation sufficiently to cause sloughing. It should be borne in mind that the operation is so simple and painless that it can be repeated as often as necessary to accomplish the desired result, so that it is foolish to attempt too much at one sitting.

Little or no swelling follows the injection, and the after-treatment consists in confining the patient to bed for twenty-four hours as a precaution and keeping him under observation for some days. Iced cloths or a 25 per cent. solution

of aluminum acetate on cloths may be applied if edema or inflammation seem to require it.

Paraffin injections not only push the cellular tissue aside, but infiltrate it to a greater or less extent, so that if too much paraffin is injected it is impossible to remove it without removing the cellular tissue in which it is imbedded. After all inflammation has subsided the mass feels somewhat like a little mass of fat beneath the skin, and is somewhat readily movable upon the bone beneath.

Unfavorable results from subcutaneous injections of paraffin have been reported as follows :

Infection followed by slough or abscess. Infection can be avoided by careful sterilization and by care to avoid leaving a cylinder of paraffin extending through the skin to the mass beneath.

Pressure necrosis, produced by injecting too much paraffin at one sitting or beneath the skin where it is tightly bound down by adhesions.

Deformity from hyperinjection or depositing the paraffin in the wrong place. Ordinary skill, prudence, and the proper technic will prevent such a disaster from occurring.

Several cases of embolism have been reported from the injection of *fluid* vaselin or paraffin. When the paraffin is injected as a solid the danger is less imminent. It will, however, be well to have an assistant compress the sides of the root of the nose between his thumb and forefinger while the injection is being made.

Congenital Deformities of the Nose.—The most common of the congenital deformities of the nose are a bulbous condition of the end of the nose and extreme prominence of the bridge. The latter is readily removed in the following manner: An incision is made through the skin and periosteum down to the bone. The periosteum is then stripped from the bone and the parts exposed. It is now a comparatively simple matter to remove the redundant bone and cartilage by means of a burr driven by a dental engine. The skin and periosteum are then placed in their former position and the wound brought together by buried sutures, which leave no stitch-marks and a linear scar, which, in a year or two, becomes practically invisible.

When bulbous enlargement of the tip of the nose is excessive the redundant skin and fat is best treated by the method of Rodman of Philadelphia, who removes a pear-shaped piece of skin and subcutaneous structures, being careful not to disturb the cartilaginous framework of the nose. In cases where the deformity is less pronounced, the operation devised by Roe of Rochester serves every purpose.

The end of the nose is turned upward and backward and held with a retractor by an assistant; then sufficient of the superfluous tissue is removed or dissected out from the inside of the nose to allow the nose to conform to the shape that we desire. Great care must, however, be exercised not to cut through into the skin, lest we may have afterward a scar or dent in the external surface of the nose.

DISEASES OF THE ACCESSORY SINUSES OF THE NOSE

The cavities found in the bones of the skull communicating with the nasal chambers are the antra of Highmore or the maxillary sinuses; the anterior, middle, and posterior ethmoid cells; the sphenoid cells, and frontal sinuses. The relative position of these sinuses in the face is shown in Fig. 94.

The accessory sinuses are phylogenetically ancient structures and, like the appendix, are residual organs, although their presence in the skull adds lightness without greatly diminishing the strength of the bones of the face and nose. The antrum of Highmore has its prototype in the amphibian accessory nasal chamber, which is an organ of smell. Like other residual organs, the accessory sinuses vary greatly in size and shape in different individuals. They are all supplied by the trifacial nerve, and this fact should be borne in mind in tracing the route of reflex phenomena. Like all residual organs they offer a comparatively feeble resistance to the onset of inflammation.

Differential Diagnosis Between Diseases of the Accessory Cavities.—In disease of the antrum, the frontal sinus, and the anterior ethmoid cells the discharge makes its way anteriorly and is blown from the nose. In disease of the

middle and posterior ethmoid cells and the sphenoidal sinuses most of the pus finds its way into the pharynx.

Placing the head well forward between the knees or lying upon the unaffected side favors a discharge of pus from the maxillary antrum, while the upright position favors a discharge from the other sinuses.

Orbital abscess with consequent exophthalmos is most frequently the result of disease of the ethmoid bone, but

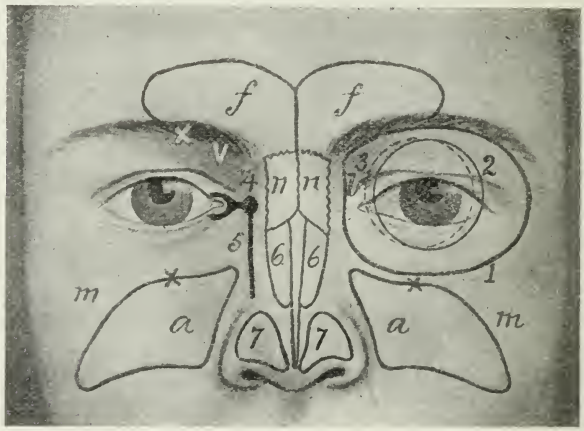


FIG 94.—Relation of accessory sinuses, nasal bones and cartilages, canaliculi and nasal ducts, and sac to surface. Projection upon surface of outer margins of orbital cavity, of conjunctival sac, and of globus oculi upon surface; *A*, Antra of Highmore; *F*, frontal sinuses (the white cross above the right upper lid shows the relation of the supra-orbital nerve to the frontal sinus; the black cross just beneath the lower lid indicates the relation of the infra-orbital nerve to the antrum); *N*, nasal bones; 1, projection of margin of orbit upon surface; 2, projection of eyeball (globus oculi) on surface; 3, projection of conjunctival sac upon surface; 4, lacrimal sac; 5, nasal duct (from the lacrimal sac to the inner ends of both eyelids the lacrimal canals can be seen terminating at the eyelids in the puncta lacrimalia); 6, lateral cartilage of nose (between the cartilage of each side is the cartilaginous portion of the septum, upon which they rest); 7, alar cartilages. (Modified after Eisendrath.)

may occur as the result of sphenoid disease. Ptosis, strabismus, or sudden blindness is generally the result of disease of the sphenoid, but narrowing of the field of vision may also occur as the result of ethmoiditis or disease of the antrum of Highmore. Facial neuralgia is most commonly caused by disease of the maxillary antrum. Crust formations on the middle turbinate are most common in ethmoidal suppuration, but may be present when there is a scanty

discharge from either the maxillary or frontal sinus or from the ethmoid cells.

Inflammation of the antrum of Highmore may be divided clinically into four classes: Acute and chronic catarrhal inflammation and acute and chronic purulent inflammation.

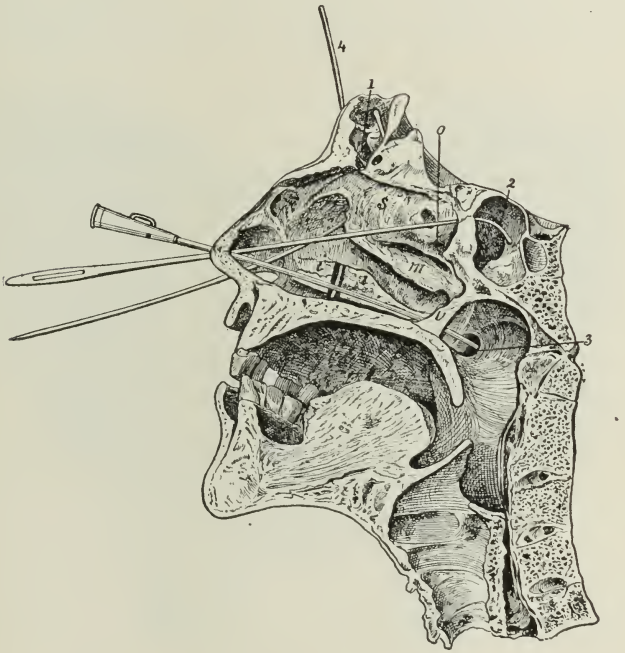


FIG. 95.—1, Frontal sinus, with probe entering it through the adnasal duct; 2, sphenoid antrum, with probe entering it through its ostium; 3, pharyngeal orifice of the Eustachian tube, with catheter in position; 4, Bowman's probe passed through the nasal duct into the nose, a portion of the inferior turbinated body has been cut away in order to show the point at which the probe enters the nose; *s*, *m*, *i*, superior, middle, and inferior turbinated bodies; *O*, ostium of the posterior ethmoid cells opening into the superior meatus; *V*, posterior portion of the Vomer; the rest of the septum has been cut away. (From a dried preparation.)

Catarrhal inflammation of the lining mucous membrane of the antrum, as is usual in all closed cavities, often degenerates into purulent disease, the pus finding its exit through the ostium maxillare and escaping into the nose.

Etiology.—The fangs of the first and second molar teeth usually extend into the floor of the antrum, the apex of

the fangs not infrequently reaching a level above that of the rest of the floor of the antrum (Fig. 96). Under these circumstances it is easy to understand how caries of these molar teeth would result in infection of the antrum, and undoubtedly caries of the molars involving the pulp-cavities of their roots preponderates in the etiology of chronic suppuration. However, a common cause of antrum disease is closure of the ostium maxillare as the result of hypertrophic

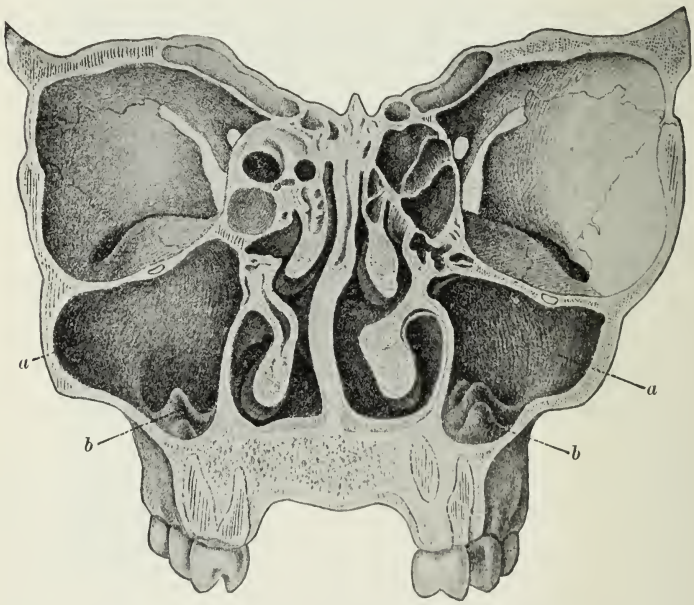


FIG. 96.—Transverse section of the maxillary sinuses (Zuckerkandl).

rhinitis and polypoid degeneration of the mucous membrane about this opening. Some acute cases can be traced directly to the effects of taking cold. The antrum may also be infected from disease of the ethmoid cells, the frontal sinuses, the sphenoid sinuses, syphilitic necrosis, etc.

Pathology.—Soon after the onset of the disease the mucous membrane of the antrum becomes greatly swollen and edematous and a large amount of seromucus is poured out. The inflammation may gradually subside at this stage

or the secretion may become purulent. The deeper layer of the mucous membrane, which in this locality is the periosteum, also partakes of the inflammation in chronic cases, and exostoses are formed, which, in the form of lamina of bone, may project into the antrum in such a manner as to nearly divide it into two or more small chambers. The mucous membrane of the antrum in some cases becomes enormously hypertrophied, pulpy, and covered with granulations and polypi.

Symptoms.—At the beginning of the attack there is a sense of fulness and pressure beneath the orbit, and pain, sometimes agonizing in character, involving the whole side of the face. Mastication is generally painful, the teeth of the affected side feeling as if elongated and crowded out of their sockets. These symptoms are due to a collection of fluid within the antrum and closure of the ostium maxillare and may last for several days, when the fluid is either evacuated through the ostium maxillare or by an opening through the thin median wall; in rare cases, the alveolus, the cheek, or the orbit. After this spontaneous evacuation the pus flows for a time, the course of the disease being marked by periods of retention, during which there is more or less pain, terminating by a discharge of somewhat fetid pus from the nostril. Some cases, however, pursue a chronic course from the commencement, there being at no time complete closure of the ostium maxillare and retention.

Diagnosis.—A discharge of pus from one nostril, especially if periodic in character, which smells and tastes fetid to the patient, should always excite the suspicion of disease of the antrum. Upon inspection the pus will be found flowing from beneath the middle turbinated body. This pus should be carefully wiped away with absorbent cotton and the patient be directed to lie down upon the unaffected side for ten or fifteen minutes, when, if pus reappears beneath the middle turbinated body, it is probable that its source is the maxillary antrum. If, while the patient is in a dark room, a 3-candle-power electric lamp (Fig. 97) is placed within his mouth, the face will be lit up by transmitted light, and the outlines of each antrum can be mapped out if both are empty. If one is filled with fluid or any other material, that

side of the face will appear darker. The observer should also observe the manner in which the light is transmitted into each nasal chamber, and more especially through the eyeballs. In some cases the antrum may contain fluid, and yet both sides of the face and each nasal chamber will be equally illuminated by the transmitted light from the electric lamp within the mouth; but if the pupil of each eye be observed, that of the unaffected side will be the brighter. *x*-ray photographs often give valuable information as to the extent and size of the adnasal sinuses and presence or absence of disease; and in cases where it is suspected that disease not only of the antrum but also of other accessory cavities exists, this additional means of information should not be neglected.

FIG. 97.—Ferguson's antrum illuminator.

Prognosis.—Spontaneous resolution generally occurs in acute catarrhal cases, the result of transient closure of the ostium maxillare from simply taking cold. Chronic suppuration of the antrum rarely if ever gets well spontaneously.

Treatment.—In acute catarrhal cases an effort should be made to restore the patency of the ostium maxillare in the following manner: The parts about the middle turbinated body should be thoroughly cocainized by means of pieces of absorbent cotton saturated with a 4 per cent. solution of cocain placed within the middle meatus, after which an application of a 4 per cent. solution of antipyrin and a 3 per cent. solution of menthol in olive oil should be made with an atomizer, and the parts then covered with powdered calomel. These applications should be made daily at the physician's office, the patient in the meanwhile using at home every hour or two a spray of adrenalin of the strength of 1 : 10,000.

Treated in this manner, resolution generally occurs in three or four days.

It should be borne in mind that all of the accessory sinuses of the nose can be inflated with air in the same manner as the ear by means of *Politzer's air-bag*. The parts in the neighborhood of the ostium maxillare should be cocainized in order to render this orifice as patulous as possible. The patient should then lie down with the affected antrum uppermost, and puff out his cheeks and close the auditory meati with the forefinger-tips, in order to protect as far as possible the middle ear from overinflation. The Politzer air-bag is now filled with the vapor of iodin-chloroform (Formula 92), its nozzle inserted into the nostril, both alæ being closed about it with the thumb and fingers of the left hand in such a manner as to produce an air-tight joint. The bag is then suddenly compressed with the right hand and chloroform vapor enters all the accessory cavities of the nose as well as the middle ear. With the patient in the position described above air bubbles through an accumulation of mucus or mucopus in the antrum and forces it out through the ostium maxillare into the nose, and the procedure may be repeated sufficiently often to completely empty this cavity, the chloroform vapor acting as an anesthetic antiseptic, and the heat of the parts causes it to expand to a greater bulk than an equal volume of air would do.

This method of treatment is especially useful in the early stages of disease of any of the nasal accessory cavities. The intense frontal headache sometimes resulting from vacuum congestion of the frontal sinuses in acute nasal catarrh can be relieved quickly by applying pledgets of absorbent cotton saturated with a 4 per cent. solution of cocain to the neighborhood of the infundibuli and, after their removal, inflating with chloroform-menthol or chloroform-iodin vapor the frontal sinuses in the manner described above.

The Politzer air-bag is filled with chloroform-menthol vapor by the following method: A glass-stoppered bottle is kept partly full of chloroform in which some crystals of menthol are dissolved. The portion of the bottle above the level of the fluid soon becomes filled with the vapor of chloroform-menthol, and it is only necessary to insert the nose-

piece of the Politzer bag in the mouth of the bottle and allow the bag to expand to fill it with menthol-chloroform vapor.

The accessory sinuses can also be inflated by *Valsalva's method*, that is, closing the nose and blowing violently into it. They may be aspirated by inserting the nozzle of a Politzer bag into the patient's nose and allowing the empty bag to expand while the patient is blowing out his cheeks. Closing one nostril and sniffing the inspired air violently through the open nostril has a tendency to aspirate the accessory sinuses. In some cases the rarefaction of the air by this method in an inflamed antrum is sufficient to cause pain, and in certain cases is sufficient to enable a patient to aspirate fluid from his antrum when in the horizontal position with the affected antrum uppermost.

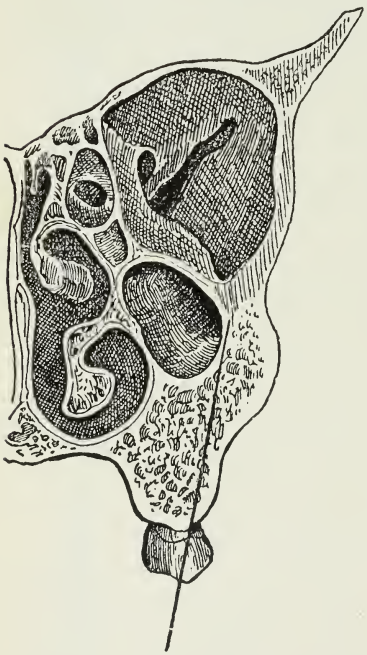


FIG. 98.—Illustrating the difficulty of opening the antrum through the root-cavities when the antrum is small or abnormal in location (*Jour. of Laryn.*, Oct., 1895).

Acute cases of antrum disease should be treated by the surgeon once a day in the manner described above. The patient, in the meanwhile, should spray his nose every two hours with a 1 : 5000 solution of adrenalin. Treated in this manner there is frequently little or no pain after the first inflation.

In chronic cases efficient drainage is of primary importance. This may be accomplished by drawing the second molar tooth and penetrating the antrum through the socket of its inner fang by means of a small trocar and cannula. In the majority of instances this is readily accomplished, but Fig. 98 shows a section of a skull where it is difficult

to reach the antrum by this route. In such cases the trocar may be made to pierce the cavity of the antrum through the canine fossa or, preferably, through the inner wall of the

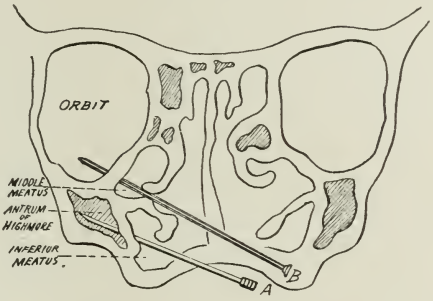


FIG. 99.—Section through the nose, showing needle (*B*) entering the orbital cavity through the middle meatus when the lateral wall slopes outword; *A* shows needle entering the antrum through the inferior meatus. Outline: Zuckerkandl, Anatomie der Nasenhohle. (Coffin.)

nose beneath the inferior turbinated body by means of Halle's trocar and cannula (Fig. 100). The parts are first cocainized in the usual manner and the trocar and cannula thrust

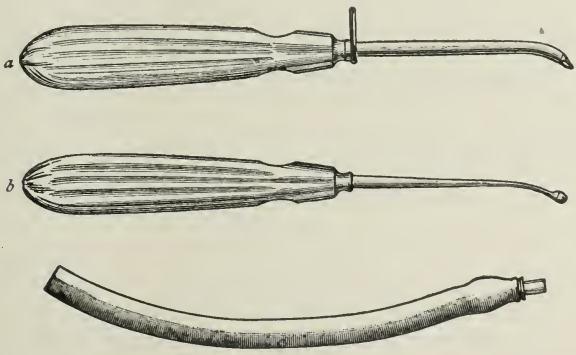


FIG. 100.—Halle's trocar and cannula for piercing the antrum through the inferior meatus: *a*, Trocar and cannula; *b*, probe or obturator, by means of which the cannula can be introduced daily into the antrum through the opening made by the trocar.

through the thin bone beneath the inferior turbinate in an inward, outward, and upward direction. The trocar is then withdrawn and the antrum washed out through the cannula.

The opening thus made remains for some time patulous and there usually is no difficulty in reinserting the cannula and blunt obturator (Fig. 100, *b*) as required from day to day. When an attempt is made to open the antrum through the nose the proximity of the orbit should be remembered. The antrum varies in size from a capacity of less than 2 fluiddrams to as many fluidounces. Small antra may be the result of lack of development of the entire side of the face or encroachment of the nasal wall or great concavity of the floor of the orbit. Douglas observed a case in which the antrum was greatly narrowed by a curious guttering of the floor of the orbit into the antrum.

No matter in which position the opening of the antrum is made, the cavity should be thoroughly cleansed once a day by means of a suitable syringe. The antrum should first be irrigated with warm borated water in order to remove the major portion of the accumulated mucus. Equal parts of Dobell's solution and peroxid of hydrogen should then be thrown into the antrum and allowed to bubble out through the nose for a moment or two. The antrum is then again irrigated with warm borated water. A quantity of 1 per cent. or even 2 per cent. nitrate of silver solution sufficient to completely fill the antrum is then thrown in and allowed to remain for half a minute or longer, and is then washed out with the boric acid solution and the antrum dried by means of a current of warm air. This thorough treatment should be done by the surgeon each day. When the opening is made through the alveolus, its patency can be maintained by means of a plug of aluminum worn by the patient.

When the opening is made through the alveolus it is possible for the patient to wash out his antrum by means of a fountain syringe provided with a suitable nozzle. When it is impossible to visit the surgeon's office at frequent intervals, this should be done once or twice a day by means of a quart or more of saturated boric acid solution used as hot as can be tolerated. Cures of this disease are sometimes brought about by this method.

In the treatment of diseases of the maxillary antrum it seems needless to remark that any coexisting disease of the

nasal chambers should receive the careful attention of the surgeon.

In a certain percentage of cases these milder measures are insufficient to bring about a cure. For cases of this kind operations have been devised known as *Kuster's*, the *Caldwell-Luc*, and *Jansen's*. Jansen claims that when one sinus is involved all the sinuses of that side of the face are probably more or less affected, and hence opens all of the sinuses at one operation.

After the patient has been etherized the jaws are separated by a mouth-gag inserted on the side opposite to that to be operated on. To prevent blood reaching the pharynx from the mouth a strip of gauze may be packed between the jaws and the cheek as far back as possible beyond the wound, and removed from time to time when it becomes saturated with clots. The tongue is controlled by means of suitable forceps or a suture inserted through its tip, so that it may be drawn forward when necessary to sponge blood from the pharynx should any reach that locality from the posterior nares. The patient should lie on the side to be operated on with the head in such a position as to facilitate the gravitation of blood from the nose and mouth, but if blood reaches the pharynx it can be removed by gauze sponges held in long hemostats.

The cheek is retracted by means of a blunt retractor and an incision made at the junction of the cheek with the jaw from the posterior border of the alveolus to the anterior border of the canine fossa. The anterior and lateral bony surface of the antrum is then uncovered by means of a periosteum elevator, and the bone removed by means of a chisel and rongeur forceps as far forward as the nasal wall and as far backward as the anterior border of the masseter muscle, and vertically from the floor of the antrum to near the infra-orbital canal. If the lining membrane is not wounded the operation up to this point will probably be nearly bloodless.

The mucous membrane is now incised and the cavity of the antrum examined by means of the finger and, after hemorrhage has ceased, inspected. The mucous membrane will probably be found immensely thickened, granular, and

covered with pus. One or more mucous polypi may be present and exposed bone detected with the finger-tip. The diseased mucous membrane is now thoroughly removed with a sharp curet, and, if possible, with the same instrument, a large portion of the bony nasal wall of the antrum, the little finger being inserted in the nose to facilitate the procedure.

In cases where the ethmoid cells and sphenoid antrum are normal, the operation should be concluded without the further destruction of tissue. However, where the ethmoid cells are known to be diseased, they may be thoroughly opened or cureted away as far back as the sphenoid antrum, the anterior wall of which may also be removed with the curet if necessary.

The remains of the nasal mucous membrane of the nasal wall of the antrum are now turned into the antrum to replace as far as possible its own mucous membrane

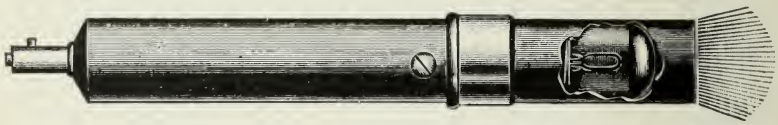


FIG. 101.—Frontal sinus illuminator.

previously removed by the curet, and the cavity is loosely packed with iodoform gauze. The oral wound should not be stitched. In the course of time it contracts to a small opening or becomes permanently closed.

The gauze packing is removed in whole or in part on the second or third day, and may or may not be replaced as seems better in the judgment of the surgeon. After the gauze has been permanently removed the antrum should be cleansed daily with sterile water or Dobell's solution until the healing process is complete. This occurs in the course of five or six weeks, the antrum being greatly reduced in size during the process.

Occasionally the frontal sinus drains directly into the antrum, and under such circumstances, if the frontal sinus were the seat of purulent inflammation, it would be impossible to bring about a cure of the antrum disease as long as the purulent inflammation of the sinus existed.

Inflammation of the Frontal Sinus.—Acute catarrh of the frontal sinus probably is more common than similar disease of any of the other accessory sinuses. The disease, however, more rarely goes on to suppuration because the infundibulum often affords ample drainage from the most dependent portion of the cavity. Suppuration in the frontal sinus probably only occurs as the result of comparatively

FIG. 102.—Acute catarrh of the frontal sinus. (Photograph by Pfahler.)

long closure of the infundibulum, traumatism, gonorrheal infection, maggots in the nose, syphilis, and the development of tumors within the sinus.

The *symptoms* are frontal headache, which sometimes develops into severe pain, with nausea and vomiting. When the transilluminator (Fig. 101) is placed beneath the brow, the light is transmitted better by a large normal sinus than by one containing pus or a tumor. However, the size and

shape of the frontal sinus varies so greatly in different individuals that a much more satisfactory result can be obtained by an *x*-ray photograph than by transillumination. It is usually possible, by means of a good photograph, to not only determine whether the sinus contains pus or a tumor but also secure valuable information as to its size, the presence or absence of septa, the condition and size of the ethmoid cells, the antra of Highmore, etc.

FIG. 103.—Case shown in Fig. 102 after recovery. Treatment consisted of removal of a small polypus from beneath the middle turbinated body and daily inflation of sinus with chloroform-iodin vapor, which was invariably successful in controlling pain for several hours. (Photograph by Pfahler.)

Treatment.—The headache and pain can sometimes be relieved in the following manner: The parts about the infundibulum are first thoroughly cocainized. The nozzle of a Politzer bag filled with the vapor of chloroform or

menthol is then so placed within the nose that its orifice points toward the infundibulum and the patient is told to "puff out" his cheeks. If now the rubber bag is suddenly compressed, some of the vapor may penetrate the frontal sinus and be followed by instant relief from frontal headache and pain. Should this maneuver succeed, Politzer's bag should be used in the manner described at sufficiently

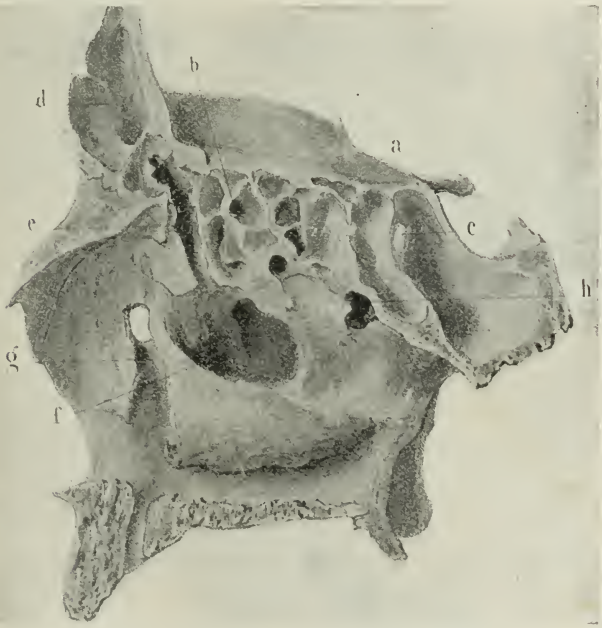


FIG. 104.—*a*, Posterior ethmoid cells; *b*, anterior ethmoid cells having no communication with the posterior cells; *c*, sphenoid sinus and its communication with the posterior ethmoid cells; *d*, frontal sinus; *e*, infundibulum communicating with the middle meatus; *f*, maxillary sinus; *g*, nasal canal communicating with the lacrimal sac. (Hirschfeld.)

frequent intervals to prevent a return of the frontal headache. The patient should spray his nose every two hours with a 1 : 10,000 solution of adrenalin as a home treatment, and every effort should be made to maintain the infundibulum in a patulous condition until the inflammation of the frontal sinus subsides. To prevent recurrent attacks of catarrhal inflammation of the sinus it may be desirable to remove the anterior portion of the middle turbinated body.

The distance from the floor of the frontal sinus through the nasal frontal duct is rarely more than $\frac{3}{8}$ inch. The distance from the nasal end of the duct to the lower border of the bulba ethmoidalis, the lowest possible region of

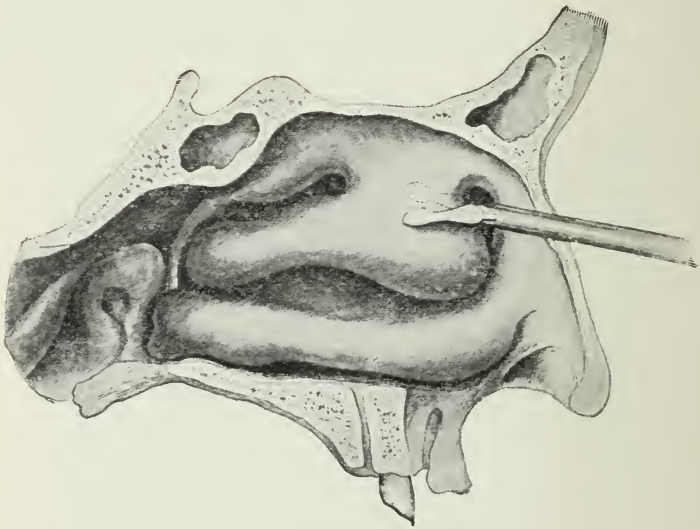


FIG. 105.

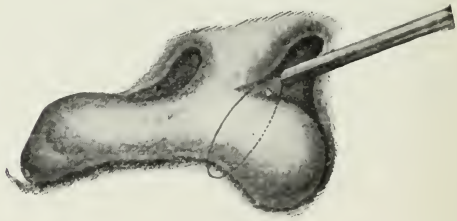


FIG. 106.

FIGS. 105, 106.—Removal of anterior end of middle turbinated body with forceps and snare (Grunwald).

obstruction to frontal drainage, is about $\frac{3}{4}$ inch (Fig. 104). When using adrenalin the patient should be told to direct the spray from an atomizer so that it will reach the middle turbinate region. Not infrequently a small polypus is

found beneath the middle turbinate anteriorly, and its removal is followed by a cessation of recurrent attacks of frontal sinus inflammation. However, the obstruction generally is due to hyperemia and swelling of either the lateral wall of the middle turbinated body or the mucous membrane of the hiatus semilunaris, the uncinate process, and the bulba ethmoidalis. Suitably treated, at least 95 per cent. of acute cases recover without operation, but where relapses are frequent it is advisable to remove the anterior third of the middle turbinate with Grünwald's forceps and snare (Figs. 105, 106) to facilitate treatment.

Chronic Purulent Disease of the Frontal Sinus.—*Symptoms.*—The headache is usually persistent, but may assume an intermittent type. There may be deep-seated pain on pressure on the bone over the frontal sinus. Upon inspection the parts about the infundibulum will be found red and swollen and covered by a small amount of pus, sometimes offensive in character. If the discharge is greatly obstructed, the roof of the orbit may be so far crowded downward as to produce displacement of the eyeball with diplopia or even amaurosis, while the anterior wall of the cavity may bulge forward in such a manner as to produce marked facial deformity. Should the posterior wall be displaced, dulness, apathy, increased headache, and other symptoms referable to the brain will probably manifest themselves. Meningitis or brain-abscess may occur.

Treatment.—Chronic cases require irrigation with a mild alkaline solution. This may be accomplished by means of Hartmann's cannula (Fig. 107) screwed on to syringe *c*, Fig. 38. This cannula should be made of virgin silver, so that its curve can be slightly changed to suit varying conditions. The parts are first cocainized with a pledget of cotton saturated with a 4 per cent. solution of cocain and then sprayed with a 1 : 1000 solution of adrenalin, and an effort made to probe the sinus with a small virgin silver probe. Should the probe enter the sinus, it is withdrawn; the shape of the Hartmann cannula is bent to correspond with that of the probe and, after being screwed on to the syringe, is inserted in the sinus. The solution used for syringing should be of a temperature of about 120° F.,

and great gentleness should be employed in syringing to avoid giving pain.

If the cannula fits somewhat loosely into the adnasal duct, so that fluid syringed into the frontal sinus readily escapes around the cannula, it will be safe to add a proportion of peroxid of hydrogen to the fluid used for syringing. However, if there is any obstruction to the return flow of fluid syringed into the sinus the use of this substance should be avoided. After the sinus has been thoroughly cleansed, any retained fluid should be removed by blowing air through the cannula with the syringe-bulb. After the sinus has been cleansed and dried, $\frac{1}{2}$ dram of a 10 per cent. solution of argyrol should be injected through the cannula

FIG. 107.—Hartmann's frontal sinus cannula. The instrument should be so constructed as to screw on to *a*, *b*, or *c*, Fig. 38, and the tube made of pure soft silver, so that its curve can readily be slightly changed.

by means of syringe *a*, Fig. 38, and allowed to remain. The action of this solution is that of a sedative, slightly astringent antiseptic. It spreads itself over the walls of of the sinus and is either absorbed or slowly dribbles out through the adnasal duct into the nose.

Instead of employing Hartmann's cannula, the cannula 5 or 6, Fig. 38, if suitably curved, may be used. The conic shape of this cannula is an advantage in some cases, and when employed with the conic nozzle 7, Fig. 38, does away with the necessity of unscrewing the syringe from the cannula each time it is refilled with fluid.

Most cases of chronic suppuration of the frontal sinus are greatly improved by syringing and the application of argyrol. There remains, however, a certain proportion of cases

where, as the result of hyperplasia of the mucous membrane, the presence of polypi or necrosed bone, these measures are not adequate, and under such circumstances, in order to effect a cure of the chronic suppuration, it is necessary to make a sufficiently large opening through the external plate of the frontal bone to thoroughly expose the sinus. In most of such cases in order to effect a cure it will be necessary to curet away every vestige of mucous membrane, pack the sinus with gauze, and allow it to fill up with granulations until practically obliterated.

Bryan, Hajek, Killian, Agston, Luc, and Kuhnt have devised operations for exposing the frontal sinus by removing a portion of its external wall.

In chiseling into the frontal sinus it should be borne in mind that the suture at the root of the nose between the nasal bone, nasal process of superior maxillary, and the frontal bone is on a level with the floor of the sinus. This suture is T shaped and usually easily demonstrated when the bone has been denuded of periosteum. The chiseling should be done immediately above the center of this suture beneath the superciliary ridge until the antrum has been encountered, after which the bony opening should be enlarged sufficiently with rongeur forceps; but in order to prevent deformity the superciliary ridge should be encroached upon as little as possible. However, Kuster, Lathrop, and others have devised osteoplastic operations in which a flap of periosteum and bone is replaced after the sinus has been cureted.

The nasofrontal duct should be located with a probe and enlarged only at the expense of the anterior and median wall in order to avoid opening the cranial cavity. Some operators advocate passing one end of a strip of gauze from the antrum, after it has been cureted, through the nasofrontal duct into the nose. The strip of gauze is seesawed back and forth until it has removed all the mucous membrane of this passage. The end of the strip protruding from the nose is then cut off close up to the naris and the other end of the gauze packed into the antrum as a first dressing. The gauze is removed daily and the antrum syringed with a 1 : 2000 solution of sublimate and repacked

until it has filled with granulations. At the end of one or two weeks this process generally has sufficiently advanced to permit closing the skin wound; after which, if necessary, the parts may be irrigated through the nose by means of Hartmann's cannula. Because the sinus is obliterated completely by the granulations that finally completely fill it, the amount of depression over the former location of the antrum and the consequent deformity is less than would be expected.

Killian's operation consists, after first shaving off the hair of the eyebrow and sterilizing the field of operation, in making an incision through the skin and periosteum from the temporal end of the eyebrow to the middle of the base of the nose. The sinus is then exposed with a chisel, care being taken not to wound its lining mucous membrane in order to prevent hemorrhage. The vertical elevation of the sinus is discovered by reference to a skiagraph taken previous to the operation and by inserting a probe between the mucous membrane and bone. A vertical incision through the skin and periosteum is now made from the highest point to which the sinus extends down to the nasal end of the original wound, thus producing a triangular flap of skin and periosteum which is dissected upward from the bone.

A sufficient amount of the outer table of the frontal bone is now removed with chisel and rongeur forceps to permit of the entire mucous membrane lining the sinus being cureted away. The ethmoid cells and even the sphenoid antrum may, if necessary, be opened. The bony floor of the antrum at its nasal portion is next chiseled away and the nasal mucous membrane incised longitudinally and stretched into the wound. The flap of skin and periosteum is replaced and stitched into position. The patient is instructed not to blow his nose, but to suck all secretions into his pharynx.

Mucocele of the frontal sinus is a retention cyst containing a serous exudate from the mucous membrane. The contents of the cyst are prevented from escaping by partial or complete occlusion of the nasofrontal duct.

Symptoms.—Pain, neuralgic in character, due to pressure caused by the accumulation. The pressure may be so

great as to cause the tumor to bulge into the nose. The bone over the frontal sinus, especially the orbital portion, is painful on pressure.

Treatment.—If the cystocele bulges into the nose, it should be incised and its contents allowed to escape. When there is no bulging into the nose and an *x*-ray photograph discloses the probable presence of a fluid within the frontal sinus, the sinus should be opened and the contents of the cyst evacuated and free drainage established into the nose before the external opening is allowed to close.

Inflammation of the Ethmoid Cells.—The most common diseases affecting the ethmoidal sinuses are acute and chronic catarrhal inflammation and purulent disease. Purulent disease of the ethmoid cells is usually associated with caries or necrosis of the bony structures, and is sometimes followed by exophthalmos, orbital abscess, and even meningitis and death. The name *necrosing ethmoiditis* was employed by Woakes of London to designate an inflammation usually resulting in caries or necrosis of the inferior turbinated process and other parts of the ethmoid bone ; characterized, after caries has occurred, by the presence of a tenacious, creamy white, mucopurulent discharge from a sinus or cleft in the middle turbinated body, and usually by the presence of exuberant granulations and polypi, the result of the irritation of necrosed spicules of bone upon the surrounding soft tissues. While the conclusions of Woakes have not received general acceptance by laryngologists, yet the following diagrams (Figs. 108, 109) represent very well indeed conditions not infrequently resulting from ethmoid disease.

Pathology.—The mucous membrane of this portion of the nose extends inward to line the cells and trabeculæ of the middle turbinated body, and is inseparable as a membrane from the periosteum beneath. Inflammation of this mucoperiosteum results in necrosis. The inflamed mucous membrane and cellular tissue, proliferating after its kind, forms large masses of granulation tissue and polypi. These polypi partake more or less of a fibrous character in proportion to the amount of connective tissue involved in the proliferating process. The process of ex-

foliation is not always characterized by the presence of exuberant granulations or mucous polypi, but there is always a discharge of tenacious, creamy mucopus, which adheres to the orifice of the sinus or cleft from which it exudes. Sometimes after the exfoliation of the necrosed bone the disease undergoes a spontaneous cure, a crater or cleft in the middle turbinated body indicating the spot from which the dead bone has exfoliated (Fig. 111).

When the deeper cells of the ethmoid are involved the pus, instead of finding its way into the nose, sometimes breaks through into the orbit with resulting orbital abscess.

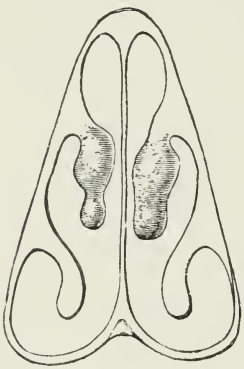


FIG. 108.—Diagram showing an early stage of ethmoiditis (Woakes).

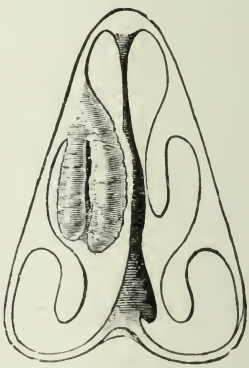


FIG. 109.—More advanced stage of the same disease, showing "cleavage" of the middle turbinated bodies (Woakes).

In some cases of orbital abscess pressure on the eyeball results in a flow of pus into the nose.

Symptoms.—An early stage of the disease is well represented in Fig. 108. A red and swollen middle turbinated body may press upon the septum. Should both turbinated bones be diseased, the septum is nipped between the hypertrophied bodies, and reflex skin rashes upon the face, such as erythema or acne, or eye disease, or any of the reflex nasal symptoms previously mentioned, may be present.

In Fig. 110 "cleavage," with exfoliation of necrosed bone, is taking place, while from the clefts polypi or proliferating granulation tissue protrudes. Fig. 109 shows "cleavage"

without proliferation of the soft tissues, the commonest form of the affection. From the cleft or from a sinus in the bone exudes a creamy, tenacious mucus, which the patient removes from his nose with great difficulty. At this stage of the disease nasal asthma and cough or paresis of the soft palate are reflex symptoms often present.

Treatment.—Drainage from the ethmoid cells can be greatly improved by the removal of a portion of the middle turbinated body, either by means of the snare or, when there is sufficient space, nasal scissors or Myles' or Grünwald's forceps. In cases where the ethmoid cells lie very

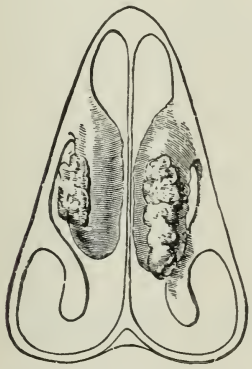


FIG. 110.—Granulation tissue protruding from the clefts in the middle turbinated bones (Woakes).

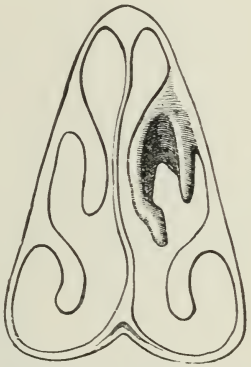


FIG. 111.—Crater-like cleft in the turbinated bone, resulting from necrosing ethmoiditis (Woakes).

superficial this operation, which is easily accomplished, gives notable relief. When an orbital abscess has formed it should be opened and, if deemed necessary, the curet used until a sufficiently wide opening is established into the nose. The parts are then packed with gauze, which is renewed from day to day, care being used at each dressing to maintain the opening into the nose until the parts have thoroughly healed, the curet being used from time to time if necessary.

Myles' nasal cutting forceps (Fig. 112) is a very useful instrument for removing quickly granulation tissue and small portions of diseased bone. With this admirable instrument the diseased portion of the middle turbinal can

generally be cut away quickly and easily and leaves a clean smooth wound. However, occasionally portions of sclerosed bone are encountered too hard to be cut away with the Myles forceps, and under such circumstances Grünwald's

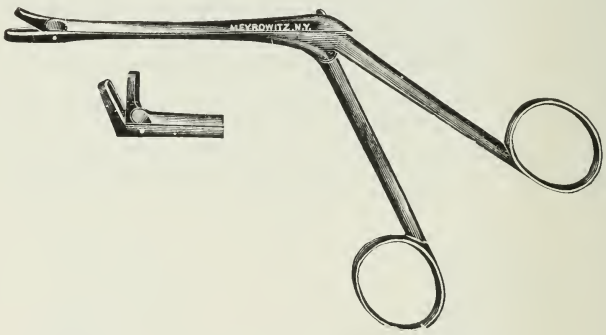


FIG. 112.—Myles' alligator nasal cutting forceps.

forceps (Fig. 113) will accomplish the desired result, although much more slowly. Both instruments are necessarily somewhat bulky, and occasionally there is not room between the septum and the turbinated bone to admit of their being

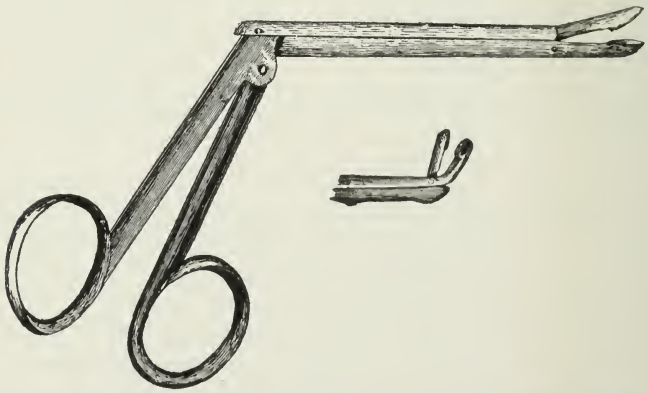


FIG. 113.—Grünwald's cutting forceps, for operation on the middle turbinal.

used. Under such circumstances a nasal curet, the trephine (Fig. 62), or a burr provided with a suitable shield should be employed to remove all tissue that interferes with the proper drainage of the parts.

Prognosis.—The course of the disease, even under proper treatment and operative procedures, is generally tedious, but a cure is sooner or later brought about by persistent effort, while in some instances it may be quickly and easily obtained

Empyema of the Sphenoidal Cells.—It is probable that catarrhal disease of the sphenoidal cells is of not infrequent occurrence. Generally it subsides spontaneously. However, the situation of the ostium sphenoidium is such as to favor the development of purulent disease of the sphenoid with final necrosis, and there are numerous cases in which this has occurred.

Symptoms.—Purulent discharge through the nose and pharynx; pain, at first in the upper part of the throat, and later involving the whole side of the face. Ocular symptoms occur as the result of the proximity of the optic foramina, and vary from impairment of the periphery of the field of vision to complete blindness.

The *treatment* should consist in the use of disinfectant sprays and washes (Formulas 1 to 10) and the application of alterative solutions to the mucous membrane of the upper part of the nose and vault of the pharynx. This will suffice for the milder cases of acute catarrhal inflammation.

A silver probe, slightly curved at the tip, passed between the septum and middle turbinated body just above its inferior border can be moved about in such a manner as often to enter the opening into the sphenoid antrum (Fig. 95). When the opening into the antrum has been thus located, a long silver tube (Fig. 38, 4), fitted to syringe *c*, can be made to follow the tract of the probe and the antrum cleansed and medicated. For washing out the antrum either normal salt solution or a saturated boric acid solution may be employed.

Treatment is greatly facilitated by the removal of as large a portion of the middle turbinate as possible. When this has been done, the ostium may be enlarged by means of a curet sufficiently to permit the use of Grünwald's forceps, with which as large a portion of the anterior wall of the sinus as is necessary may be clipped away.

THE PHARYNX

ANATOMY OF THE PHARYNX

The pharynx is a conic, musculomembranous bag suspended base up from the basilar process of the occipital bone. It extends downward to the lower border of the cricoid cartilage and fifth cervical vertebra, where it merges into the esophagus. It is composed of three layers—an inner, mucous; a middle, fibrous, sometimes called the pharyngeal aponeurosis; and an outer, muscular layer.

Relations of the Pharynx.—Posteriorly the pharynx is connected by loose cellular tissue with the first five cervical vertebræ (Fig. 95). The second, or atlas, forming a promontory extending forward into the pharynx on a level with the palate. On each side posteriorly are the longus colli and recti capiti antici muscles (Fig. 114). Laterally are the styloid processes with their muscles, the internal carotid arteries, the internal jugular vein, the eighth, ninth, and sympathetic nerves. Near its apex are the lobes of the thyroid gland, the common carotid and lingual arteries, the lingual nerves, and the sternohyoid muscle.

Divisions.—The pharynx is divided into the nasopharynx, sometimes called the posterior nasal space, the oropharynx, and laryngopharynx. The nasopharynx extends downward to the edge of the soft palate, the oropharynx from this to a line drawn through the cornua of the hyoid bone, and the laryngopharynx the rest of the distance to the commencement of the esophagus at the fifth cervical vertebra.

Attachments.—The pharynx is attached to the internal pterygoid plate, pterygomaxillary ligament, inferior maxillary bone, base of the tongue, cornua of hyoid bone, stylohyoid ligament, and the thyroid and cricoid cartilages.

Muscles.—There are seven muscles—the superior, middle, and inferior constrictors, two stylopharyngei, and two palato-

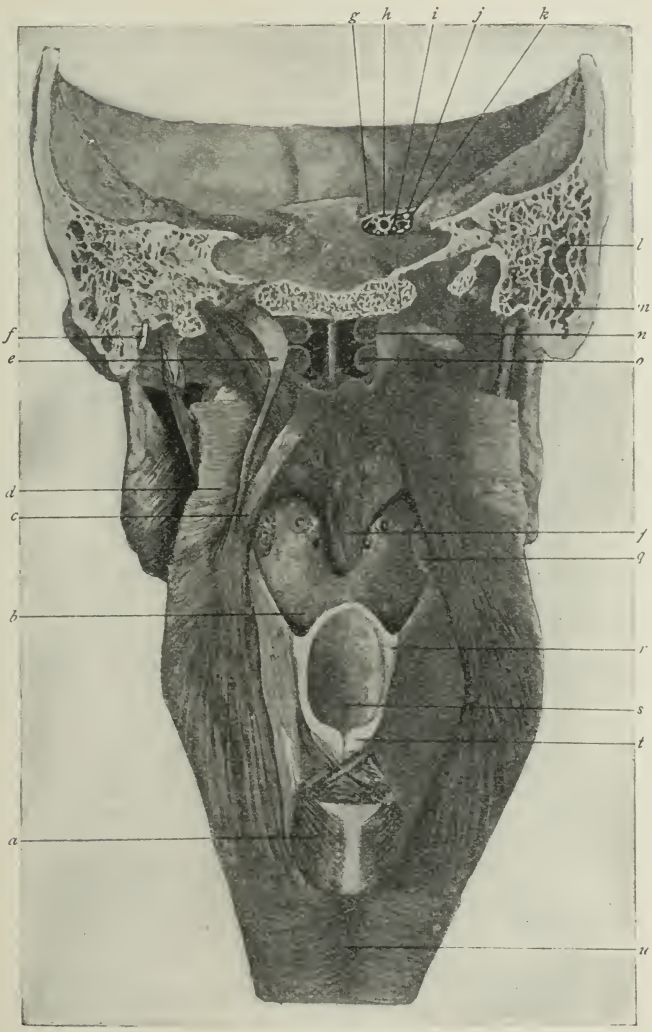


FIG. 114.—Posterior view of pharynx and larynx, as shown in a coronal section of the skull made through the level of the mastoid processes: *a*, Posterior crico-arytenoid muele; *b*, lingual tonsil; *c* palatopharyngeus; *d*, stylopharyngeus; *e*, cartilaginous portion of Eustachian tube and levator palati; *f*, facial nerve; *g*, cavernous sinus; *h*, internal carotid; *i*, sixth nerve; *j*, third nerve; *k*, fourth nerve; *l*, antrum of mastoid; *m*, mastoid cells; *n*, middle turbinated; *o*, inferior turbinated; *p*, azygos uvulæ; *q*, tonsil; *r*, aryteno-epiglottidean fold; *s*, aditus laryngis; *t*, tubercle of Santorini; *u*, beginning of esophagus. (Eisendrath.)

pharyngei muscles. The latter, covered by mucous membrane, form the anterior pillars of the fauces, the stylopharyngei, the posterior pillars. A not very uncommon anatomic peculiarity is that one or both the palatopharyngei are completely surrounded by mucous membrane, so that a probe can be passed between them and the rest of the outer wall of the pharynx.

Arteries.—There are four arteries supplying the pharynx —two branches of the external carotid and two branches of the internal maxillary. These are the ascending pharyngeal and branches from the superior thyroid; descending pharyngeal and pterygopalatine. Occasionally arteries as large as the radial are seen pulsating on either side beneath the mucous membrane of the pharynx. These are supposed to be displaced occipital arteries.

Nerves.—The pharynx is supplied by a plexus composed of branches from the pneumogastric, glossopharyngeal, superior laryngeal, and the superior cervical ganglion of the sympathetic.

The **mucous membrane** of the nasopharynx is covered with stratified, ciliated, columnar epithelium, the oropharynx with squamous epithelium, and the laryngopharynx with squamous and ciliated epithelium anteriorly. There are simple follicular glands, compound follicular, and racemose glands.

Tonsils and Lymphatics of the Pharynx.—The laryngopharynx has few or no lymphatics. Above the supply is profuse, being located mainly in the mucous membrane of the superior and posterior wall.

The tonsils are a part of an irregular ring of adenoid tissue surrounding the pharynx and continuous with the general lymphatic system. There are seven tonsils: the faucial, the tubal, the pharyngeal, and the lingual. The faucial tonsils are situated one on each side of the fauces between the anterior and posterior pillars of the fauces. The lingual tonsils are situated at the base of the tongue, the tubal tonsils at the pharyngeal Eustachian orifices, and the pharyngeal tonsil in the vault of the pharynx posterior to the nasal orifices. Any of these tonsils when hypertrophied may cause annoying symptoms, especially in child-

hood; the third or pharyngeal tonsil, the so-called adenoid vegetations.

Above the tonsils and between the anterior and posterior pillars is situated the triangular *fossa supratonsillaris*. Here a number of crypts extend vertically into the tonsil, the retention of whose excretions is supposed to play an important rôle in the production of peritonsillar abscess. The number of crypts, both vertical and horizontal, rarely exceeds fifteen for each tonsil. They vary in length from $\frac{1}{4}$ to $\frac{3}{4}$ inch or possibly even more in tonsillar hypertrophy (Fig. 122). The tonsils are frequently adherent to the anterior pillars in such a manner as to form pouches, which are most effective culture-tubes for the propagation of pathogenic organisms.

The *functions* of the tonsils are similar to those of other lymphatic glands. As a part of the hemopoietic system they form young leukocytes, most of which pass into the circulation, but some escape into the free mucous surface, where they may exercise a phagocytic action. They also excite old leukocytes, which probably carry off with them effete products. According to G. B. Wood, the faucial tonsils drain into the deep lymphatics and not the superficial lymphatics of the neck. The "tonsillar gland," Wood states, is placed external and slightly anterior to the internal jugular vein. Hypertrophy of this gland means its dislocation outward and forward, but generally it can be pushed back under the sternocleidomastoid muscle, which is not the case with hypertrophied superficial glands. In a child one week old this gland was but little larger than its fellows, while in children who were six or more months of age the "tonsillar gland" was twice to four times larger. "Does it not seem possible," Wood states, "that this enlargement consequent to birth may be due to the absorption of toxins through the faucial tonsils?"

The tonsils are most active during youth, while the thymus, a large blood-forming gland, is atrophying. There is considerable difference of opinion as to the phagocytic action of the tonsils, some authorities claiming that they are not even able to protect themselves, and that the tonsils constitute a weak part of the throat and expose the system to

the inroads of diphtheria, tuberculosis, syphilis, and other diseases.

In evidence of the difference in the behavior of tonsillar epithelium toward dust and bacteriæ, Jonathan Wright dusted carmin over the tonsil. Fifteen minutes later all the particles of carmin had passed through the epithelium into deeper layers and could be detected in sections under the miscroscope ; while bacteria, situated at the exact point where the carmin entered, remained quiescent and unabsorbed.

Mechanically the lingual tonsil is most apt to prove troublesome as the result of hypertrophy after middle life if at all, while hypertrophy of the faucial and pharyngeal tonsils are distinctly diseases of childhood.

DISEASES OF THE NASOPHARYNX OR POST-NASAL SPACE

Postnasal catarrh may be either secondary, as when a nasal catarrh discharges into the postnasal space, or the disease may be primary and extend to either the nose or Eustachian tubes. The nasopharynx may be blocked by

FIG. 115.—Adenoid vegetations.

posterior hypertrophies of the turbinated bodies or by polypi, cysts, fibroid tumors, or malignant growths, springing from the posterior nares or from the vault of the pharynx. A somewhat common affection beginning gener-

ally in childhood is hypertrophy of the pharyngeal or Luschka's tonsil.

Adenoid vegetations or **hypertrophy of the pharyngeal tonsil** (Fig. 115) is an overgrowth of the normal adenoid tissue of the pharyngeal vault. The affection is often associated with hypertrophy of the faucial tonsils, and generally commences in childhood, but may be met with in patients of any age.

FIG. 116.—Typic appearance in adenoid vegetations: boy ten years old (Frühwald).

Symptoms.—If the adenoid vegetations are at all large, they block up the posterior nares and compel mouth-breathing, the pinched nostrils and half-open mouth giving the face a vacant and well-nigh idiotic expression (Fig. 116), which ordinarily disappears as soon as nasal respiration is reestablished. However, if mouth-breathing be continued into adult life permanent deformity of the bones of the face and even of the chest sometimes results. Breathing is audible, even during the day, and there is always loud snor-

ing during sleep. The voice is toneless, articulation is indistinct, and the hearing is often impaired.

Treatment.—Adenoid vegetations tend to no longer obstruct nasal respiration as the individual passes into adult age and the nose and nasopharynx grows larger, but may, in the meantime, have produced irreparable injury to the ears, and even have altered the shape of the bones of the face. Application of Formula 33 to the postnasal space will sometimes bring about a slow absorption of the hypertrophied tissue. In children, when the growth is not large, such applications should be made by the surgeon two or three times a week, the parents in the meantime cleansing the nose night and morning with the spray from an atomizer containing an alkaline wash and afterward placing in each of the child's nostrils a mass of gallic acid ointment the size of a pea.

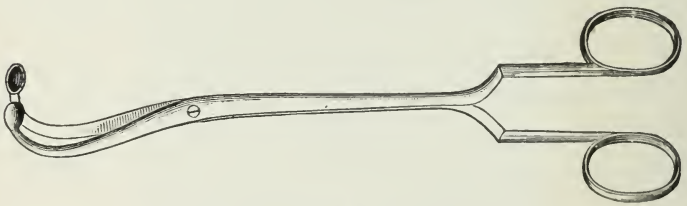


Fig. 117.—Löwenburg's postnasal forceps.

The child should then lie on its back for a few moments until the ointment melts and runs into the nasopharynx. The gallic acid ointment should be of the strength of 5 to 10 gr. to 1 ounce of vaselin, according to the age of the child. However, the only treatment adequate in the majority of cases is a thorough removal of the mass by surgical procedures. Often the masses of adenoid tissue are so soft that they can be scraped away by means of the forefinger introduced behind the soft palate. In adults Löwenburg's postnasal cutting forceps (Fig. 117) may be used; the operator being careful to begin operating in the median line, and working from it in each direction until the entire mass is cut and torn away from its attachment, at the same time being exceedingly careful not to wound the orifices of the Eustachian tubes.

In children, or in adults in whom the pharyngeal tonsil is still comparatively soft, Gottstein's curet (Fig. 118) is a most efficient instrument. Young children should be seated in the lap of a nurse upon a piano stool opposite the operator, in the same manner as for an ordinary examination of the nose and pharynx. The nurse passes her arms beneath those of the child and places her hands, one on each side of the child's forehead, in such a manner as to control the movements of the head. The nurse then elevates her elbows so as to bring the child's arms into such a position that it is impossible for the child to reach its mouth with its hands. The curet is now passed behind the palate, and the handle of the instrument depressed until the outer edge of the ring is felt to rest against the septum. By sweeping the ring upward, backward, and downward against the pharyngeal wall the growth is brought within the curet and is scraped from its attachment. Without removing the instrument from the mouth the maneuver is quickly repeated

FIG. 118.—Gottstein's improved nasal curet.

at each side of the median line, in order to be certain that the major portion of the growth has been removed. The operation should be performed quickly, but with gentleness, little force being required to sever the growth from its attachment.

The nurse then releases the child's head, and the operator passes his left arm around the child's head and thrusts his forefinger hard against the child's cheek, in such a manner that the cheek protrudes between the child's open jaws so as to form a most efficient mouth-gag. The operator then quickly passes the forefinger of his right hand behind the child's palate until the posterior edge of the septum is felt. The posterior nares, Rosenmüller's fossæ, and the vault of the pharynx are inspected, as it were, by the sense of touch. If any shreds of the growth remain they are removed with the finger-nail, scraping them from below, upward,

and forward. Before removing his finger the operator should spare no pains to assure himself by the sense of touch not only that nothing remains to obstruct nasal respiration, but that Rosenmüller's fossæ are freed from any mass likely to interfere with the blood-supply of the Eustachian tubes. However, it should be borne in mind that the third tonsil is normal to the nasopharynx, and that it is neither necessary nor desirable to remove the whole of the adenoid tissue, but simply that portion which interferes with nasal respiration and the functions of the Eustachian tubes. In very young children the parts of the growth removed by the curet are either swallowed, expectorated, or blown through the nose. The hemorrhage following the operation is generally trifling and the after-treatment consists simply in keeping the parts clean with an antiseptic wash (Formulas 1 to 10).

When a general anesthetic is employed it should be ether and not chloroform, because in this condition, the so-called "habitus lymphaticus" of Kalisko, chloroform is especially dangerous, somewhat numerous deaths having been reported. The ether should not be pushed to complete abolition of the reflexes, as even when only partially etherized the patient will probably become momentarily blue from partial asphyxia caused by the quantity of blood that generally enters the larynx.

Ether is rarely if ever necessary to secure an adequate removal of the hypertrophy. However, the major portion of successful operators prefer to operate under ether anesthesia, stating that the operation then can be done more deliberately, and there is less danger of failure to remove all portions of the hypertrophy that are pathologic. The use of the forceps and the cureting should not be so radical as to expose the fibrous tissue overlying the verterbæ or expose or tear loose the upper border of the superior constrictor of the pharynx. During the operation the patient's head should be turned to one side or allowed to hang downward over the edge of the table in order to favor the escape of blood from the mouth and nose.

The improvement in nasal respiration and in pronunciation following the operation is immediate and pronounced;

and if hearing was impaired as the result of interference with the function of the Eustachian tubes, the acuteness of hearing rapidly improves after the operation. In adults the reaction from the operation is but trifling. Children, however, sometimes complain for a few days that the throat is sore and that it hurts them to swallow.

Thornwaldt's Disease or Chronic Bursitis.—The bursa of the pharyngeal tonsil was described by Luschka, and chronic inflammation of this structure was later elucidated by Thornwaldt, after whom the disease has been named.

Symptoms.—When chronically inflamed the bursa of the third tonsil secretes a considerable amount of thick, tenacious mucus, globular masses of which may be hawked out by the patient from the pharynx several times a day. There are no other subjective symptoms in uncomplicated cases. When thoroughly cleansed by the postnasal syringe the bursa is discernible and may be explored to a variable depth by means of a probe suitably bent.

Treatment.—The concensus of opinion seems to be that a permanent cure can only be effected by the radical destruction of the bursa by means of the galvanocautery or some other method, a most difficult matter to accomplish because of the anatomic situation of the bursa. However, almost complete cessation of the discharge, for the time being at least, can be brought about by thorough cleansing of the parts and applications to the interior of the bursa, by means of a cotton-tipped probe, of a solution of nitrate of silver (60 gr. to 1 ounce).

In some cases the bursa can be cleansed by means of the syringe-tip 4, Fig. 38, suitably bent and inserted in the bursa either through the nose or the mouth. After washing out the bursa with an alkaline solution, to which a portion of peroxid of hydrogen is added, a few drops of a 25 or 50 per cent. solution of argyrol may be instilled into the cavity of the bursa through the same tube by means of syringe *a*, Fig. 38, two or three times a week.

DISEASES OF THE OROPHARYNX

Acute Pharyngitis.—Acute pharyngitis is an acute inflammation of the mucous membrane and underlying structures of the pharynx.

The *synonyms* are acute sore throat; acute pharyngeal catarrh; angina catarrhalis.

Etiology.—Acute pharyngitis is generally the result of exposure to wet and cold, especially of persons of the rheumatic diathesis or of debilitated constitutions. It may also result from traumatism or the presence of a foreign body in the pharynx. Slight unilateral pharyngitis is not uncommon after an intranasal operation, and is probably due to a mild infection. It lasts for a day or two and then passes away.

Pathology.—The inflammation is usually by no means evenly distributed, the glandular elements being always most affected. Their secretion is at first increased, but becomes after a time decreased, starchy, and glue-like in character. The tonsils are always involved to a greater or less extent, their inflammation becoming so great in some instances as to mask the inflammation of adjacent structures.

Symptoms.—The constitutional symptoms are usually trifling, a feeling of lassitude with slight fever. The throat feels sore, dry, and stiff. The symptoms may increase until pain, especially when deglutition is attempted, becomes quite severe. The cervical glands are often swollen and painful to the touch. The voice is usually husky and a sensation as of a foreign body in the throat keeps the patient hawking and spitting. When the tonsils or larynx are seriously involved in the inflammation certain other symptoms are present, which will be described further on.

Treatment.—A saline cathartic should be administered in sufficient quantities to secure one or more free movements of the bowels. A solution of nitrate of silver of the strength of 1 or 2 drams to 1 ounce of water should be freely painted over the inflamed lateral walls once or twice a day. It should be borne in mind that the application of solutions of the strength of 1 or 2 drams to 1 ounce of water is not painful, providing none of the solution is ap-

plied to the posterior wall. It is immediately followed by a sensation of relief and comfort, and tends to materially shorten the course of the disease. Applied to the posterior pharyngeal wall solutions of silver nitrate of over 5 or 10 gr. to 1 ounce produce a sensation of dryness, stiffness, and discomfort. In this region a 10 per cent. solution of argyrol sprayed upon the parts is preferable to the use of the nitrate. When acute pharyngitis is the result of the presence of a foreign body it should, of course, be at once removed and the inflamed pharynx treated as ordinary acute pharyngitis. When the rheumatic diathesis exists, the administration of guaiac (Formulas 138, 139) will be found to yield most excellent results, while in gouty sore throat colchicum should be prescribed. A spray of adrenalin chlorid (1 : 5000) used every hour by the patient quickly relieves the congestion in most cases; but other astringent sprays are sometimes equally efficient, the best probably is alumnol 1 dram to 4 ounces of water. If it is inconvenient for the patient to use an atomizer, lozenges may be prescribed. The camphomenthol lozenge (Formula 142) is sedative and relieves the feeling of dryness and stiffness by increasing the secretions, and the same may be said of a lozenge of guaiac and potassium iodid. However, one of the most popular lozenges in this condition is that of guaiac and tannic acid (Formula 140).

Simple chronic pharyngitis is a chronic inflammation of the mucous membrane of the pharynx, generally the result of chronic rhinitis. The disease is often complicated by inflammation of the follicles of the mucous membrane, and is then called follicular pharyngitis.

Synonyms.—Chronic sore throat; granular pharyngitis; follicular pharyngitis; chronic angina; relaxed throat; chronic catarrh of the throat.

Treatment.—It is all important to bring about a cure of the nasal disease to the presence of which the pharyngeal malady is due. After a cure of the primary nasal affection has been brought about, simple chronic pharyngitis will get well almost without treatment. During the treatment of the nasal affection, however, applications should be made to the vault of the pharynx of Formulas 33, 34, or 35 in the

following manner: A tongue-depressor (Figs. 10–12) should be used to hold down the tongue and the patient requested to try to breathe through his nose or say "One," in order to relax the palatine muscles, when the application may be made without difficulty by means of an applicator, the end of which has been wrapped with cotton and bent to a suitable curve. Should, however, the palate lie closely in contact with the pharyngeal wall, considerable force will be required to carry the end of the applicator into the post-nasal space, while most of the solution with which the cotton on the end of the applicator has been saturated will be squeezed out and remain in the fauces. Applications made in such a manner tend rather to increase the existing inflammation than to subdue it, and it is always best to desist from making an application to the pharyngeal vault rather than employ force. When the uvula has become elongated or the mucous membrane of the fauces relaxed as the result of constant *hawking*, the daily application of the spray from an atomizer containing a solution of sulphate of copper (2 gr. to 1 ounce of water) will render material assistance in restoring the "relaxed throat" to a condition of health. In some instances it is necessary to amputate the relaxed and redundant mucous membrane at the tip of the uvula.

Chronic follicular pharyngitis, or clergyman's sore throat, is a chronic pharyngitis characterized by inflamed and hypertrophied lymph-follicles.

Pathology.—The pathology is similar to simple chronic pharyngitis, except that the lymph-follicles are involved in larger numbers and to a greater degree. The subdivision of pharyngitis into pharyngitis and follicular pharyngitis is a matter of convenience rather than fact, as in all simple inflammations of the pharynx the mucosa, the lymph-follicles, the submucosa, and often the muscles are usually involved in varying degrees. The watery portion of the secretions are decreased, and hence the expectorations are thick and glue-like from an increased proportion of mucin, epithelium débris, and mineral salts.

Etiology.—The disease is generally the result of or part of a nasopharyngeal catarrh, excessive or faulty use of the

voice, excessive use of tobacco and distilled liquors, the rheumatic or gouty diathesis, indigestion, and, in women, pelvic diseases.

Symptoms.—The secretions are usually somewhat scanty and viscid, but voided with considerable difficulty. There is a short, frequent cough, distressing alike to patient and friends; the so-called "useless cough," because it accomplishes nothing, either in ridding the throat of secretions or the constant pharyngeal irritation of which many of these patients complain.

The appearance of the pharynx varies somewhat; usually there is venous hyperemia over the entire surface, but greatest in the neighborhood of patches of hyperplastic follicles. In other cases the pharynx is less congested, the hypertrophied follicles projecting above the surrounding surface and surrounded by varicosities. Sometimes a number of inflamed follicles coalesce in such a manner as to form a red, sore, and swollen area of considerable size. If such patches be situated close to the posterior pillars, so that they are rubbed and irritated by these folds of mucous membrane with every motion of the pharyngeal muscles, the sufferings of the patient amount to actual pain.

Treatment.—The irritability of the mucous membrane covering areas of hypertrophied follicles can be decreased by lightly painting with a 60-gr. solution of nitrate of silver. However, care should be exercised to prevent the silver solution spreading over the surrounding mucous surface, because strong solutions of silver nitrate are irritating when applied to the *posterior* wall of the oropharynx.

A certain amount of relief is experienced by the use of demulcent lozenges, either slippery elm, red gum, camphomenthol (Formula 142), or, better still in many instances, a lozenge of orthoform.

Where the so-called useless cough is a prominent symptom it should be controlled by appropriate doses of sodium bromid. For this purpose as much as 10 or 15 gr. after meals and at bedtime will be required. The matter is of considerable importance, as the constant coughing greatly irritates the pharynx and increases the existing inflammation.

The condition of the tonsils should be carefully examined.

Often they are slightly hypertrophied and the crypts contain cholesteatomatous masses. The removal of any concomitant disease of the nasal cavities also will have much to do with the success of treatment.

FIG. 119.—Emil Mayer's pharyngeal curet.

With many practitioners the radical destruction of the diseased glands by means of the *galvanocautery* is a favorite method of treatment. A very small cautery-knife should be selected, and great care should be exercised not to burn too deeply, or the resulting scar will cause more trouble than the original disease. It is unwise to apply the galvanocautery-knife to more than two or three hypertrophied follicles at one time, or the treatment may be followed by a somewhat sharp attack of acute pharyngitis.

Emil Mayer of New York curets away the offending follicles by means of a special curet (Fig. 119). By this method of treatment, which is much less painful than the use of the galvanocautery, all the hypertrophied follicles are removed at a single sitting.

Atrophic pharyngitis is an atrophic condition of the mucous membrane and submucous tissues of the pharynx.

The *synonyms* are pharyngitis sicca; dry pharyngitis.

Etiology.—Atrophic pharyngitis generally results from long contact with the irritating discharges of nasal catarrhs. It frequently exists when atrophic rhinitis is present, being probably the result of an extension of the atrophic process to the pharyngeal mucous membrane. A dry condition of the faucial mucous membrane, amounting almost to pharyngitis sicca, is found in all mouth-breathers, but disappears spontaneously as soon as the nose has been rendered sufficiently patulous.

Symptoms.—The patient complains of his throat feeling

dry and stiff. Upon inspection, the mucous membrane of the throat appears light colored, thin, and as if varnished. Frequently the mucous membrane is so thin that the outline of each cervical vertebræ can be distinguished. Sometimes masses of inspissated mucus, perhaps dark colored from the dust inhaled, and swept into ridges by the motions of the soft palate, are seen adhering to the atrophied mucous membrane.

Treatment.—Attention should be mainly directed to the condition of the interior of the nose, because it is the experience of most rhinologists that when a cure of the nasal affection has been brought about the concomitant throat disease will get well almost without treatment. The general health should receive attention and, if necessary, tonics should be prescribed; while a sluggish condition of the bowels may indicate the use of saline laxatives. If atrophic rhinitis has caused the affection, plugs of cotton, previously mentioned as useful in atrophic rhinitis, should be made long enough to project somewhat from the posterior nares into the pharynx, while a weak solution of nitrate of silver (gr. v–xv to f℥j) should be applied to the atrophied mucous membrane, both above and below the soft palate, to stimulate the atrophied glands to increased secretion and bring about renewed growth of the atrophied structures. In certain cases it may be advisable to give for a short time some drug like iodid of potassium, phosphorus, or muriate of ammonia to stimulate the pharyngeal secretions. A pill containing $\frac{1}{100}$ gr. of phosphorus may be given after meals or the lozenge of guaiac and iodid of potassium, one every three or four hours, may be ordered. It should be borne in mind that the stomach does not tolerate well any lengthy administration of these remedies and in most cases their use is best avoided.

Mycosis of the pharynx is a parasitic disease involving in most cases the faucial, pharyngeal, and lingual tonsils, although other parts of the pharyngeal mucous membrane do not escape in some instances. It is characterized by little white, conic elevations, sometimes as large as a grain of rice, due to the presence of fungi of the class mycosis, most frequently the leptothrix buccalis.

Etiology.—Leptothrix is so frequently found in the secretions of the mouth that it might almost be termed a normal constituent. It is especially prevalent in the mouths of individuals with carious teeth, accumulations of tartar, etc. Why it should in some individuals cause the horny, chalk-white growths characteristic of mycosis is not well understood.

Pathology.—Leptothrix penetrates the lacunæ of the tonsils and the glands of the mucous membrane of the pharynx Multiplication of the threads takes place, so that they grow through the epithelial cells and appear on the free surface of the mucous membrane, where they appear as whitish masses, generally cone shaped, the base of the cones adhering tightly to the mucous membrane and their apices projecting into the pharynx. Under the microscope the cones are seen to consist of granular material, a few epithelial cells, and numerous threads of leptothrix. These threads when stained are seen to be jointed and contain numerous spores.

Symptoms.—A few masses of leptothrix may be present in the pharynx without causing any symptoms whatever. Under such circumstances the masses may be discovered, usually upon the tonsils, while examining the throat of a patient. Usually, however, patients with leptothrix complain of a tickling sensation in the pharynx and spasmodic cough.

Treatment.—On the tonsils and other easily accessible portions of the pharynx the little masses should be grasped one by one and pulled off. They are attached somewhat firmly and considerable force and a suitable forceps is necessary to remove them. The smallest size of Farnham's alligator-forceps or, better, Hartmann's ear forceps answers the purpose better than most, because so firmly adherent are the little masses that they are apt to slip from the grasp of forceps with smooth jaws. After the removal of the little masses the mucous membrane where they grew should be brushed with nitrate of silver (60 gr. to 1 ounce of water). In inaccessible localities, like the base of the tongue and beneath the epiglottis, leptothrix is better attacked with the galvanocautery-knife rather than the forceps. A very

small knife, suitably curved, should be selected, and the current should be powerful enough to instantly heat the very small platinum wire white hot, when it is applied to the leptothrix cone, and destroy it before the heat has time to burn the surrounding mucous membrane by radiation, as would be the case if a larger wire, heated only red hot, were used.

As only a limited number of leptothrix cones can be destroyed at a sitting, the treatment in cases where they are very numerous is necessarily somewhat tedious. Some of the cones re-form after their removal. Applications of silver nitrate (60 gr. to 1 ounce) prevents this to a considerable extent, and occasionally when applied to the surface where leptothrix is growing will cause the cones to disappear after frequent applications. Occasionally the growths disappear spontaneously.

Erysipelas of the Pharynx.—Erysipelas of the face sometimes extends to the pharynx or the disease may originate in the pharynx.

Etiology.—Like erysipelas elsewhere the disease is the result of the presence of Fehleisen's erysipelas streptococcus.

Pathology.—The fauces are dusky red and swollen. Vesicles form on the surface filled with seropus. The disease is evidently contagious under certain circumstances, as epidemics have been described, notably that in America in 1842. Erysipelas may extend to the middle ear through the Eustachian tube or to the lungs through the larynx.

Prognosis.—In the milder cases the prognosis is good. The phlegmonous variety of the disease is almost invariably fatal.

Treatment.—The treatment is that of erysipelas elsewhere. Large doses of the tincture of the chlorid of iron (20 to 30 drops in water) should be given every three hours, with strychnin, $\frac{1}{30}$ gr., if necessary. The nose and pharynx should be sprayed with an alkaline wash every three hours, followed by adrenalin solution (1 : 1000). The spray of adrenalin should be repeated at intervals of a few moments until the parts have somewhat blanched, after which they should be covered with a 20 per cent. solution of argyrol by means of the spray from an atomizer.

Phlegmonous pharyngitis is an acute infection of the pharynx, phlegmonous in character, extending to the deeper structures and usually terminating fatally in from five to ten days.

Etiology.—The disease usually attacks those of broken-down constitutions or the aged. There is usually a history of slight traumatism, followed by virulent infection with some pus-producing organism.

Pathology.—There is an enormous swelling of the fauces at an early stage of the disease, followed by a speedy formation of pus, which infiltrates the surrounding tissues and produces pyemia. The organism present in the pus is usually the streptococcus pyogenes aureus, or there may be a mixed infection.

Symptoms.—The onset of the disease is sudden. The temperature rises to 103° or 104° F. The throat is sore and, as in a case observed by the author at the Philadelphia Hospital, the swelling may be so rapid as to necessitate tracheotomy within twenty-four hours to prevent suffocation. There are symptoms of general infection. There is a clammy perspiration, great weakness and debility, often followed by collapse and death.

Treatment.—Local treatment is of little avail. If asphyxia is imminent, tracheotomy should be resorted to, suspected abscesses should be opened, either externally through the skin by a free incision or in the pharynx if fluctuation is detected. Hourly hypodermic injections of antistreptococcus serum should be given, with large hot enemas of normal salt solution every three or four hours. Stimulative enemas also will be necessary if the patient is unable to swallow, with hypodermics of strychnin ($\frac{1}{30}$ gr.) every three or four hours to prevent collapse.

Simple Ulcer of the Pharynx.—Ulcers of the pharynx are localized areas of necrosis.

Etiology.—Most ulcers of the pharynx are either syphilis, epithelioma, or tuberculosis. However, there is an ulceration of the pharynx or fauces, generally the result of mixed infection from the ever-present bacteria of the mouth, that is occasionally observed, generally in the feeble or debilitated or those suffering from some error of metabolism.

Some cases are the result of traumatism followed by infection.

The *symptoms* vary according to the size and location of the ulceration. The pain will be severe, especially during swallowing, if the ulceration is so localized as to be irritated by the action of the faucial muscles. Under such circumstances there may be regurgitation of food through the nose. If the inflammation extends to the larynx there will be hoarseness or loss of voice, and if the tissues about the Eustachian tubes are involved by the inflammation, earache. Some of the older writers attached a considerable amount of diagnostic importance to the fact that in epitheliomatous ulceration of the pharynx and larynx pain shooting up into the ear was a common symptom. However, this symptom occurs in any pharyngeal ulceration, but is less common in syphilitic and tuberculous ulcers. If the ulceration is long continued there will be progressive loss of flesh.

Upon inspection the ulcer is seen upon the pharynx either medianly or laterally, similar in appearance to ulcerations occasionally seen upon the tonsils. It may be round or oblong. The edges are usually well defined and the ulcer may be filled with sloughing tissue, or the floor of the ulcer may be comparatively clean and so deep that when situated medianly the bone of the vertebra is bared.

Diagnosis.—The diagnosis in ulceration of the pharynx rests between syphilitic, tuberculous, epitheliomatous, and simple ulceration. The administration for a week or ten days of 10 to 20 gr. of iodid of potassium after meals and at bedtime will clear up the diagnosis as far as syphilis is concerned. There is also the method of Justis: A hemoglobin estimate is made before and after a mercurial inunction. If twenty-four hours after the inunction there is a decrease of 10 to 20 per cent. hemoglobin, the disease is probably syphilis.

Cancer of the pharynx is differentiated by examining microscopically a small section removed from the edge of the ulcer, and tuberculosis by the tuberculin-test, the condition of the patient, or by microscopic examination of the sputum.

Treatment.—The treatment of syphilitic, epitheliomatous, and tubercular ulcerations has been described elsewhere. In simple ulceration tonics and 10 or 15 gr. of pepsin should be given. The ulcer should be cleansed each day with Dobell's solution or peroxid, and an application made of nitrate of silver (60 gr. to 1 ounce of water), after which the floor of the ulcer should be dusted either with orthoform or a mixture of iodoform, tannic acid, bismuth, and morphin (Formula 58). Both the orthoform and the above powder are analgesic and relieve pain. They are also antiseptic and adhere to the ulcerated surface sometimes for hours. Of the two, the compound iodoform and tannic acid powder gives the better results.

Syphilitic pharyngitis is an inflammation of the pharynx due to the presence in the system of the syphilitic poison.

The *primary sore* is not infrequently seen. Mucous patches are by no means rare, while gummata or their characteristic cicatrices are very often met with in the pharynx, especially in dispensary practice.

Symptoms.—In primary syphilis, examination shows a whitish abrasion, soon followed by swelling of the glands about the angle of the jaw. Secondary lesions may present either the form of mucous patches or erythema, characterized by a diffuse redness of the entire fauces or, more commonly, in the milder attacks, by a broad red line extending upward upon each of the anterior pillars, and ending abruptly and symmetrically at the root of the uvula. Mucous patches and erythematous patches in the throat are almost always symmetric; that is, both sides of the throat are attacked in corresponding localities by similar lesions, while tertiary lesions do not as frequently present this symmetry. Gummata more frequently involve the tonsils or soft palate than other parts of the throat. A gumma may be absorbed under treatment or, breaking down, result in a rapidly spreading ulceration. When an ulcerating gumma is situated upon the posterior wall of the pharynx, the cervical vertebræ or even the cervical cord itself may finally become involved, and a fatal issue result. In such cases also the utmost care is required to prevent union of the soft palate and uvula to the pharyngeal wall, when the ulceration has

also involved the posterior surface of the palate. Where union has actually taken place, it is almost impossible at any subsequent period to permanently restore satisfactory communication between the oropharynx and nasopharynx by any operation, because of cicatricial contraction after the operation.

Treatment.—In pharyngeal syphilis, as in syphilis elsewhere, constitutional treatment is of primary importance, and the same remedies may be employed internally as already recommended in the treatment of nasal syphilis (Formulas 73–75). If the symptoms are urgent, the hypodermic method of administering mercury should be employed, as it gives the most speedy results. Local treatment consists in maintaining perfect cleanliness of the diseased parts and stimulating mucous patches and ulcerations to heal by daily applications of the acid nitrate of mercury, diluted with 5 parts of water, and the application, by means of the powder-blower, of a small quantity of Formula 58 or 59.

Tuberculosis.—The presence of the tubercle bacilli is sometimes demonstrable by means of the microscope in the secretions of a mild chronic pharyngitis of nurses and attendants in the tuberculous wards of hospitals. Primary tuberculous pharyngitis with marked lesions is rare. Secondary tuberculous pharyngitis in phthisic patients is somewhat common, and is usually observed as ulcerations resembling those of tertiary syphilis.

Infection probably reaches the pharynx through some localized solution of continuity from the secretion of the tuberculous lungs. Tubercles form in the submucosa which finally break down and ulcerate.

Treatment.—In cases where there are no marked lung lesions and the diagnosis is obscure, antisyphilitic remedies should be administered until the surgeon has satisfied himself by the "therapeutic test" that the disease is not syphilis. The hemoglobin-test of Justis may be employed to assist in the diagnosis. When ulceration has occurred the ulcers should be cleansed with peroxid of hydrogen, cocainized, and touched with lactic acid once in two or three days. As these applications are somewhat painful, even after

cocainization, it is well not to employ a stronger solution than 25 per cent. until the amount of pain and reaction caused by the application has been ascertained, after which the concentrated syrupy acid may be employed if deemed advisable. Rarely is it necessary to employ the curet, and the prognosis as regards healing is favorable.

Lupus vulgaris is a form of inflammation involving the mucous membrane and submucous tissues of the pharynx, generally ending in ulceration due to the presence of the tubercle bacilli.

Etiology.—The disease is said to be more common on the continent of Europe than in America. It occurs in tuberculous families and in those frequently brought into contact with tuberculous patients.

Symptoms.—The general condition of the patient may be that of good health. The disease is insidious and causes little annoyance until the ulcers are sufficiently large to interfere with the functions of the parts. Early in the disease soft reddish nodules about the size of sago grains appear on one or both sides of the pharynx. These finally break down, producing ulcers which may spread to the pillars of the fauces, the palate, or the larynx, one portion of the ulceration healing while another is extending.

Pathology.—Portions of the diseased tissue cureted away show, under the microscope, typic tuberculous giant cells. However, tubercle bacilli are found only in small numbers and with difficulty.

Diagnosis.—The ulcerative stage may be mistaken for herpes, syphilis, or epithelioma. The short duration of herpes and the more rapid progress of epithelioma should serve to differentiate the disease from lupus. In suspected syphilis the "therapeutic test" serves to clear up the diagnosis. The tuberculin-test gives a positive reaction, causing local hyperemia and some rise of temperature, which subsides in twenty-four hours. The microscope shows typic tubercle giant cells.

Treatment.—The parts should be thoroughly cureted and the solid stick of nitrate of silver applied. Cures have been reported by the use of the *x*-ray.

Glanders, farcy, or **equinia** is a contagious, specific disease

with both local and constitutional symptoms, usually contracted from infected horses. It is due to the presence of the bacillus mallei.

Symptoms and Course.—Pemphigus-like vesicles appear at the point of infection, usually the face. The vesicles ulcerate and the parts sometimes become gangrenous. Metastatic abscesses occur on the face, trunk, and extremities. In milder cases vesicles and abscesses heal in a short time and the patient recovers. In severer cases there is marked prostration, with rapid rise in temperature, headache, pain on swallowing, dryness of the throat, and enlargement of the submaxillary and cervical glands. Foul-smelling pus flows from the nose and pharynx and a purulent bronchitis is usually present. The more severe form of the disease is usually fatal.

Treatment.—Local treatment consists in cleansing the nasal and pharyngeal mucous membranes with diluted peroxid of hydrogen and detergent washes and then spraying the nose and pharynx with carbolated albolene. The systemic treatment should be supportive. There is no known specific remedy for the disease.

Actinomycosis is a parasitic, infectious, inoculable disease, first observed in cattle and later in man. It is due to the presence of the leptothrix streptothrix or ray fungus. The most frequent and curable form of the disease is when abscesses form about the jaws or fauces. When the parasite has found a nidus in the lungs or digestive tract the disease is fatal.

Etiology.—Actinomycosis is the result of inoculation with the ray fungus, which gains entrance to the mouth, pharynx, or nose from ingesta or inspired air. The disease may originate primarily in either of these cavities and, more rarely, in the larynx or ear.

Pathology.—A slow swelling occurs, usually first at the angle of the jaw, which renders swallowing difficult. Upon inspection, if suppuration has not already occurred, the mass will be found to be firm to the touch and involve one or more of the cervical glands or the tonsils. At the seat of infection a nodule occurs which breaks down and discharges pus containing typic granular masses, which, upon com-

pression, forms star-like bodies, yellowish in color, with a center which stains blue with Mallory's stain.

Symptoms.—The symptoms and pathology of the disease, as affecting the human tonsils, was first described by Jonathan Wright (1904). The symptoms are those of granulating, painless abscess with general systemic infection. The laryngologist is usually first consulted by the patient for catarrh and hypertrophied tonsils. One or more crypts of the tonsils may be suppurating and lined with granulations.

Treatment.—The affected tonsil or tonsils should be amputated. Where this cannot be done the application of the galvanocautery is the best form of treatment. Each nodule or suppurating crypt should be thoroughly destroyed. Abscesses occurring in localities other than the tonsils should be opened, cureted, and cauterized with the solid stick of nitrate of silver. Iodid of potassium in large doses is stated to inhibit the growth of the ray fungus, and Sawyer reports favorable results from the injection into tumors of from 15 to 30 minims of a 1 per cent. solution of the iodid.

Retropharyngeal abscess is an abscess of the posterior pharyngeal wall. It may be hidden above and behind the soft palate and require the rhinoscope to ascertain its outline ; it may be situated opposite the larynx, and only be seen in its entirety with the laryngoscope, or it may be situated in such a manner as to be hidden by one of the posterior pillars of the pharynx. However, the most common seat of abscess is the posterior wall of the pharynx opposite the oral cavity on one side or the other of the median line.

Etiology.—Abscess may occur as the result of phlegmonous inflammation of the cellular tissue of the pharynx, scrofula and syphilis being predisposing causes. Traumatism and necrosis of the vertebræ are sometimes causes of the affection.

Symptoms.—There is usually but slight systemic disturbance. Chilly sensations may perhaps be complained of, but local symptoms are usually the first to attract attention. When the abscess is situated high up upon the pharyngeal wall, a sensation as of a foreign body causes almost constant

hawking and spitting, while there may be present obstructed nasal respiration with more or less pain and tinnitus. When the abscess is opposite the larynx, dyspnea is a marked symptom, appearing in "spasms" which may endanger the patient's life, while swallowing of liquids or solids is dangerous, owing to their frequent passage into the larynx. In the case of an eighteen-months'-old child seen in consultation by the writer, the mere attempt to introduce a tongue-depressor into the mouth was followed by collapse and apparent death. The child's life was saved only by a rapid tracheotomy with the only available instrument, a penknife. The next day after the operation the cause of the obstructed respiration was discovered to be a retropharyngeal abscess situated low down in the pharynx opposite the larynx. The abscess was opened and the child made a good recovery.

An abscess in the pharyngeal wall opposite the oral cavity presents none of these symptoms unless very large.

Treatment.—Left to itself, a retropharyngeal abscess will discharge either into the throat or at some more remote point, but as soon as a diagnosis is established an incision should be made into the abscess at its lowest part, and the opening maintained patulous by the daily passage of a probe as long as necessary to bring about a cure of the affection.

Prognosis is favorable except in those cases where the spinal vertebræ are involved. In all operations upon the posterior wall of the pharynx it should be borne in mind that a large artery is occasionally found in this position, probably the vertebral, which sometimes enters its osseo-fibrous canal as high up as the fourth or even second vertebra. It has been seen to leave its canal at the third vertebra, to re-enter it at the atlas.

Tumors.—Any of the varieties of tumor found in other parts of the body may occur in the pharynx. They are most frequently located in the lateral walls and may involve the surrounding structures. In the following order of frequency there is found in the pharynx gumma, sarcoma, carcinoma, lupus, papilloma, cyst, fibroma, osteoma, enchondroma, adenoma, and aneurism.

Symptoms.—When the growth is large it may become an

obstruction to deglution or even respiration. In carcinoma and ulcerating lupus pain is also present, which in many instances radiates into the ear.

Treatment.—Except in the case of gumma, the treatment of which has been already described, early extirpation with the knife, galvanocautery, or snare should be practised.

NEUROSES OF THE PHARYNX

The more common neuroses of the pharynx are anesthesia, hyperesthesia, paresthesia, neuralgia, and paralysis, either unilateral or complete.

Anesthesia, as encountered in the office of the rhinologist, is most often the result of hysteria. The pharyngeal reflexes are abolished; there is a more or less complete loss of pharyngeal sensation when the parts are touched with a cotton-tipped probe. The condition is observed in cases of progressive bulbar paralysis and in the general paralysis of the insane.

Treatment.—Treatment depends on the cause of the condition. In hysteria it may be advisable to use the strong galvanic or induced current with strychnin internally, possibly in increasing doses.

Hyperesthesia is generally the result of some disease of the nose and nasopharynx that has rendered the secretions viscid and sticky, so that frequent hawking is necessary to dislodge them. The excessive use of tobacco, especially chewing-tobacco, will produce the same condition. In some cases of hyperesthesia of the pharynx the reflexes are increased to such an extent that barely touching the pharynx is sufficient to produce emesis. There is, of course, hyperesthesia of the pharynx in practically every case of acute pharyngitis.

Treatment.—Cessation of the excessive use of tobacco or cure of the nasopharyngeal catarrh that has produced the condition is ordinarily sufficient to reduce the hyperesthesia to normal and diminish the reflexes. Temporary relief is afforded by the administration of sodium bromid in doses of 10 or 15 gr. three times a day. When the reflexes are not increased to an extent to produce vomiting whenever the pharynx is sprayed, the patient should spray his pharynx

three or four times a day with an atomizer containing a solution of sulphate of copper (2 to 5 gr. to 1 ounce of water).

Paresthesia is most frequently manifested as a sensation as of a small foreign body in the pharynx. This sensation and burning, itching, or tickling, as well as spasm of the pharyngeal muscles, the well-known "globus hysteriæ," are not uncommon in hysteric females. However, in the larger proportion of these so-called hysteric cases some lesion will be found to account for the symptoms if the pharynx be carefully inspected. The most common lesions are inflamed follicles or an erosion on either side of the pharynx, posterior to the posterior pillar, or in any other position where two folds of mucous membrane rub together in deglutition.

Treatment.—The symptoms are usually quickly relieved by 10 or 15 gr. of bromid of sodium after meals and at bedtime. After relief has been secured by the use of the bromid, a general tonic treatment should be prescribed for building up the nervous system—rest, iron, quinin, phosphorus. Pil. sumbul comp., one or two after each meal, frequently yields very satisfactory results. When inflamed follicles or any erosion is found in a position where it is irritated by each movement of the pharyngeal muscles, it should be touched every day or two with a 60-gr. solution of nitrate of silver.

Paralysis of the Pharynx.—*Etiology.*—Paralysis of the pharynx may result from diphtheria or syphilis, or be the result of a cerebral affection involving the nerves that supply the pharyngeal muscles. Transient paralysis of the palate, either unilateral or bilateral, is common as the result of diphtheria; more rarely are the pharyngeal muscles also paralyzed in severe cases.

Pathology.—One or both sides of the pharynx may be involved, and one or all three of the pharyngeal constrictors be paralyzed, as well as the velum palati; but paralysis of the soft palate, either unilateral or bilateral, occurs independently as a "reflex" in ethmoiditis.

Symptoms.—Difficult deglutition; liquids being more easily swallowed than solids, but more frequently passing

into the larynx; or, when the soft palate is also paralyzed, both solids and fluids may be forced into the posterior nares through the efforts of the tongue to assist deglutition.

Treatment.—The central cause of the affection should be carefully sought and treated. In suitable cases strychnin, in gradually increasing doses until the limit of toleration has been reached, will do good; while arsenic and tonics are especially valuable where the paralysis is of diphtheritic origin.

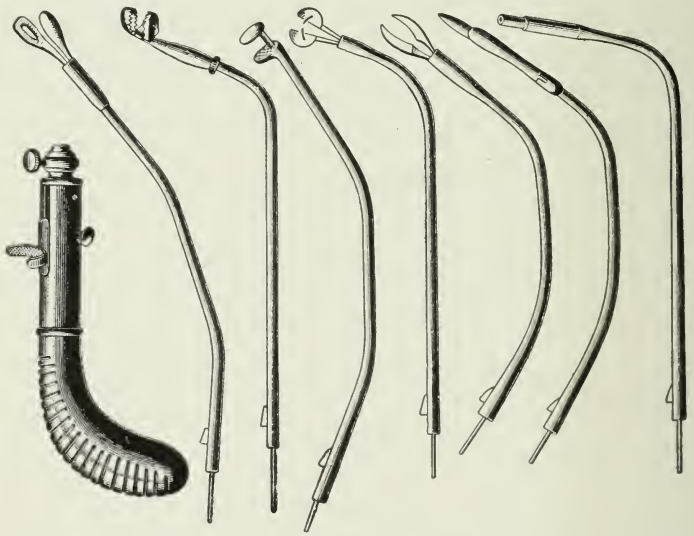


FIG. 120.—Schroeter's forceps.

Foreign bodies of two classes are found in the pharynx: First, those whose bulk does not allow them to pass through the esophagus, and secondly, sharp-pointed objects, like pins, needles, fish-bones, etc., that are forced into the pharyngeal walls by contraction of the constrictor muscles.

Symptoms.—Large objects may cause death by holding down the epiglottis. Sharp-pointed objects cause a pricking sensation, sometimes felt at two places in the pharynx, as in the case of a pin or needle. Localized spots of inflammation, when situated low down upon the pharyngeal wall, give rise to the sensation of a foreign body, and this fact,

as well as the imaginary foreign body of hysteric women, should be remembered after an unsuccessful search for a foreign substance in the pharynx.

Treatment.—It is not always possible to use the laryngoscope to advantage when the foreign body is situated low down in the pharynx, and in such cases the finger should be introduced into the pharynx, and if a foreign body be felt an effort should be made to scratch it loose with the finger-nail and withdraw it. When the offending substance can be seen, a pair of forceps, either straight or curved (Fig. 120), according to its position, should be used to withdraw it. It should be remembered that after the removal of a foreign body sometimes a sensation as of its presence remains for some days.

THE TONSILS

DISEASES OF THE TONSILS

Acute tonsillitis is an inflammation of the tonsils and adjacent structures. There are two common varieties—the croupous and the phlegmonous.

The *synonyms* are quinsy; amygdalitis; cynanche tonsillaris; angina tonsillaris; angina faucium; follicular tonsillitis; croupous tonsillitis.

Etiology.—The croupous variety of the disease (Fig. 121) is the result of infection, the disease being infectious, but probably not contagious. The phlegmonous variety (Fig. 123) is apparently often the result of exposure to cold and wet. Recurrent attacks of peritonsillitis are often the result of chronic inflammation of the tonsils, with or without hypertrophy. The cheesy secretion that is retained within the crypts (Fig. 122) becomes from time to time a source of infection and inoculates either the tonsillar structure itself or, more frequently, the surrounding cellular tissue. Deposits of fetid material between the tonsil and the anterior pillar, when the tonsil is partially adherent to it, also are capable of inoculating the adjacent cellular tissue and causing recurrent attacks of peritonsillar abscess. For these reasons excision of hypertrophied tonsils is not always followed by a cessation of recurrent attacks of quinsy, unless, after the excision, care is taken to destroy with the galvanocautery-knife all crypts that may remain in the stump of the tonsil and dissect the latter loose from the faucial pillars, should it be adherent, in order to destroy all receptacles capable of retaining putrid secretions.

However, recurrent quinsy occurs in individuals who between the attacks have apparently normal tonsils. In such cases the rheumatic and gouty diathesis also plays its part

in the production of an attack of acute tonsillitis. Phlegmonous tonsillitis is a disease of adolescence and early adult life, and does not so frequently attack individuals who are over thirty-five years of age.

Pathology.—The inflammation may be only superficial (erythematous tonsillitis) or may involve the parenchyma of the gland (parenchymatous tonsillitis). When the inflammation is deep seated, an abscess may occur either in the tonsil or more frequently in the cellular tissue about the tonsil, but the brunt of the inflammation is frequently borne by the crypts of the tonsils, which pour out an abundant fibrinous secretion, which, adhering to the surface of the

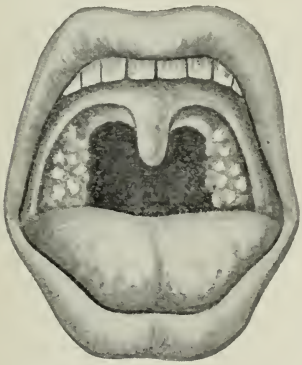
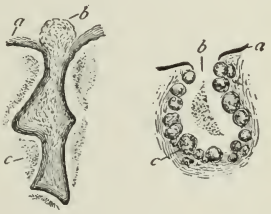


FIG. 121.—Follicular tonsillitis.



A B

FIG. 122.—Crypts in cases of tonsillitis: A, Acute lacunar; B, chronic hypertrophic; *a*, surface-epithelium; *b*, accumulated contents of crypt; *c*, lymphoid follicles surrounding crypt. (Kaufmann.)

tonsil, presents somewhat the appearance of a diphtheritic membrane (croupous tonsillitis).

Diagnosis.—By croupous tonsillitis is meant an inflammation of the tonsil, originating in the crypts and accompanied by the formation of a pseudomembrane which, at first confined to the neighborhood of the crypts, often finally extends over the entire tonsil or tonsils, if both be involved. In typic cases occurring in *adults* there is usually no difficulty in distinguishing by the unaided eye the difference between such a membrane and the more yellowish, thicker, and sometimes seminecrotic membrane of diphtheria. The croupous membrane is thin, white, perhaps opalescent, and can somewhat readily be wiped away, a small piece at a time, by

means of a cotton-tipped probe. Ordinarily it does not extend beyond the tonsils.

In some instances, however, in the case of young children, diagnosis by the unaided eye between the two affections is by no means easy. The struggles of the child allow only a momentary glance at the parts and for the same reason some bleeding may occur in the effort to remove a part of the membrane. Occasionally in such cases a thin opalescent patch occurs upon the anterior pillars or elsewhere in the neighborhood of the tonsil, whose appearance is very deceptive.

Ordinarily the temperature is higher in croupous or follicular tonsillitis than in diphtheria, but some cases, after a temperature of 103° F. or thereabouts for the first twenty-four hours, assume the characteristic lower temperature of mild diphtheria. In rare instances *albuminuria* occurs during an attack of croupous tonsillitis in children, and several competent observers have reported cases of croupous tonsillitis followed by *paralysis* of the soft palate.

Rare in the adult, at least a croupy cough is to be expected in young children with follicular tonsillitis, and sufficient laryngeal stenosis to require intubation is not impossible.

The disease is undoubtedly infectious, but some doubt exists as to its being contagious. Under the microscope several varieties of bacteria are often found in the pseudomembrane, the most constant being the streptococcus. As the streptococcus and other varieties of bacteria sometimes exist in the superficial layer of diphtheritic membranes and mask the presence of the Klebs-Löffler bacillus, which is present in the deeper parts of the pseudomembrane, even culture-tests are not always reliable as a means of diagnosis.

Symptoms.—Both in croupous and phlegmonous tonsillitis dryness and stiffness in the throat is first noticed, soon followed by dysphagia. There is a chill or chilly sensations, and pain in the legs and back, headache, and fever. As the disease progresses the sufferings of the patient become severe. The dryness of the throat causes frequent attempts at swallowing saliva, which are exceeding painful. The mouth can be opened only with pain and difficulty and

speech becomes almost unintelligible. The tongue is heavily coated and the breath intolerably fetid. The hearing is frequently blunted from extension of the disease to the Eustachian tubes, and abscess of the ear sometimes results, while nasal breathing is usually entirely abolished. The fever, pain, and difficulty of swallowing become greater and greater if an abscess is forming, and the relief is proportionately great after it has opened. As the patient expectorates the pus he feels almost well, so great is the sense of relief, the fever and pain subsiding together.

Treatment.—A thorough application of a solution of nitrate of silver, of the strength of 1 or 2 drams to 1 fluid-ounce of water, frequently aborts the attack if applied early and the inflammation is superficial. The silver solution should be freely painted upon the tonsils and adjacent inflamed mucous membrane by means of a swab of cotton. The relief experienced by the patient as the result of the application is almost instantaneous, and the application should be repeated once or twice a day until all inflammatory symptoms have subsided. The nares and pharynx should be washed by means of a spray from an atomizer containing a detergent solution (Formulas 1 to 10) before making these applications, and Formula 132 or 140 may be prescribed for the patient's use in the intervals between the applications. It is best also to open the patient's bowels thoroughly at the commencement of an attack by means of a saline cathartic. When these measures do not succeed in aborting the attack, but the fever and suffering of the patient are constantly increasing, aconite in drop doses of the tincture every hour or two will give most excellent results. When pus has formed the abscess should be opened.

The surgeon should carefully search for fluctuation by means of his forefinger introduced into the patient's mouth. As the abscess is almost always peritonsillar, a fluctuating area is most commonly felt through the anterior pillar *above* the tonsil. Into this place, the so-called point of election (Fig. 123), a small bistoury should be carefully thrust with the blade vertical, in order to avoid as far as possible cutting any large vessel that may occupy an anomalous position in this region. If a sudden cessation of resistance indicates

that an abscess-cavity has been penetrated, the blades of a pair of angular scissors or forceps should be introduced and the puncture stretched open until the pus has escaped. If necessary the opening may be enlarged by cutting downward with a probe-pointed knife. The cavity may then be washed out with sterile water. The escape of pus is followed by immediate and great relief and all symptoms usually quickly subside. Even when no pus escapes from the incision, the bleeding affords a certain amount of relief and may bring about resolution of the inflammation. The surgeon, therefore, should not hesitate to puncture a hardened but not fluctuating mass at the so-called point of election, as the procedure is usually followed by satisfactory results in cases where no pus is encountered.

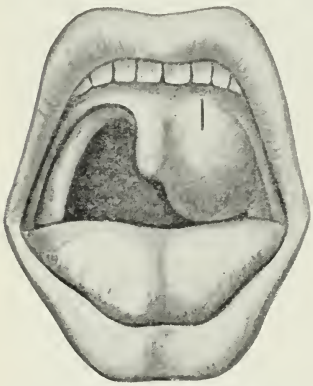


FIG. 123.—Phlegmonous tonsillitis. The black line represents the so-called point of election for puncturing a peritonsillar abscess.

Occasionally when the tonsils are adherent to the anterior or posterior pillars of the fauces an abscess will form between the tonsil and the pillar. Under such circumstances if a suspicious hardness is felt, either in front of or behind the tonsil, it should be separated from the pillar by means of a curved knife (Fig. 126). The procedure is sometimes followed by an escape of pus.

In the case of adults the writer has in many instances aborted follicular tonsillitis by the following method: Each affected crypt was in turn washed out with peroxid of hydrogen, by means of a Blake's middle-ear cannula screwed on to a hypodermic syringe. The curved tip of the cannula employed is about $\frac{1}{2}$ inch in length and capable of reaching to the bottom of the follicle. Only a drop or two of the peroxid is injected at one time, but the process is repeated until all of the exudate has disappeared. A fine Allen's probe with a few fibers of cotton wrapped about its end is then bent to an appropriate angle, and, after being dipped into a solution of nitrate of silver (1 dram

to 1 ounce), is carried to the bottom of a follicle and the process repeated until each of the affected crypts have received the silver solution. The surface of the tonsil is then painted with the same solution. The treatment is followed immediately by a sense of relief and comfort, and the difficulty in swallowing is in a great measure alleviated. The process may be repeated two or three times a day, and in successful cases brings about a cure at the end of the second or third day.

In cases of children or in adults, when as the result of timidity or excessive irritability of the fauces, this method is not applicable, spraying the parts with peroxid of hydrogen and the application of a 60-gr. solution of nitrate of

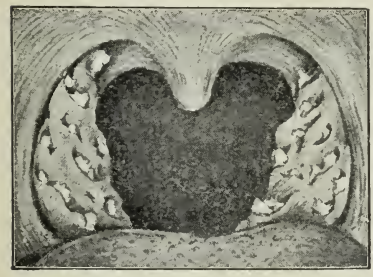


FIG. 124.—Chronic follicular tonsillitis (Frühwald).

FIG. 125.—Posterior view of the extirpated tonsil from the case illustrated in Fig. 124. Bristles have been introduced into the follicles (Frühwald).

silver suffices for the local treatment. A 60-gr. solution of silver carefully applied to the tonsils occasions little or no discomfort in health, and when the mucous membrane of this region is inflamed the solution acts as a sedative and its application is followed by a sense of relief and comfort. This, however, is by no means true of the mucous membrane covering the posterior wall of the pharynx, and care should be exercised not to irritate it by the application of the silver solution.

Chronic Inflammation of the Tonsils Without Hypertrophy.—The condition is characterized by a feeling of fulness and discomfort in the region of the tonsils. Upon inspection, the tonsils, although not hypertrophied, are redder than normal, and many of the crypts are filled with a

cheesy exudate (Figs. 124, 125). The neighboring lymphatics are usually enlarged and generally tender to the touch.

Treatment.—The cheesy exudate should be carefully removed from the crypts, and a saturated solution of iodin applied to the interior of each crypt by means of a few shreds of absorbent cotton wrapped about the end of a fine probe which is bent to a right angle. Should biweekly applications of iodin in this manner to the interior of the crypts not prove successful, a fine galvanocautery-knife should be inserted while cold into such of the crypts as resist treatment, and while *in situ* sufficiently heated to destroy the secreting surfaces and burn through the tissues to the surface. In cases where the crypts are very deep, cutting through to the surface of the tonsil is a somewhat painful procedure, and Abraham's knife (Fig. 126) had better be used for the purpose, after which the wound should be seared with the galvanocautery to prevent its reuniting during the healing process. Abraham's knife is also convenient for dissecting loose the tonsil when adherent to the faucial pillars.

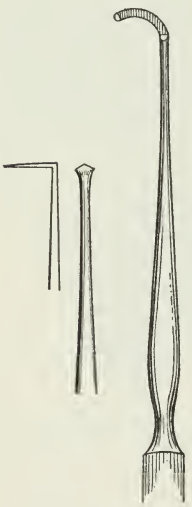


FIG. 126.—Abraham's tonsil knives. Approximately two-thirds actual size.

The cheesy secretions can readily be removed by directing against the mouth of the crypt a current of air from an air-compressor by means of the smallest-sized Eustachian catheter fitted upon the automatic cut-off (Fig. 42). Under such circumstances the little masses are blown out of the crypts with considerable force, and sometimes strike the opposite side of the pharynx.

Cyst of the Tonsil.—Occasionally the tonsil becomes the seat of cystic disease. Usually the cyst is small in size, but sometimes it may be of sufficient capacity to contain ½ dram of milky fluid or the contents of the cyst may be of cheesy consistency.

Treatment.—The anterior wall of the cyst should be excised and its interior painted with saturated tincture of iodin.

Chronic Inflammation of the Tonsils With Hypertrophy.—There are three varieties of chronic hypertrophy of the tonsils met with in practice: First, the ordinary soft hypertrophy of the tonsils found in children and young adults. Second, the so-called ragged tonsil, the result of frequent abscesses, which have caused the sloughing away of a portion of the glandular mass; and, third, the scirrhous or hard tonsil, which is characterized by an enormous increase of the connective tissue of the gland and a canalicularization of its blood-vessels.

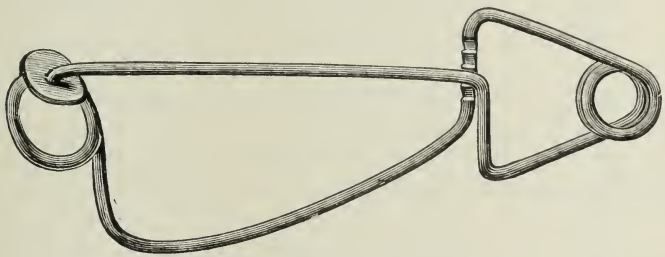


FIG. 127.—Goodwillie's tonsil-compressor.

Symptoms.—There is generally more or less obstruction to breathing: the patient snoring during sleep. The articulation is what is termed thick and there may be some difficulty in swallowing, especially in the cases of young children. The crypts of the tonsil may become filled with cheesy masses, which, undergoing putrefaction, imparts to the breath an offensive odor. Hypertrophied tonsils also sometimes interfere with the proper performance of the functions of the Eustachian tubes and thus are the cause of aural catarrh and deafness.

Treatment.—Removal of the major portion of the hypertrophied gland, either with the tonsillotome or snare or by means of the galvanocautery. Occasionally the operation with the tonsillotome is followed by dangerous hemorrhage. Under such circumstances Goodwillie's tonsil-compressor (Fig. 127) will be found convenient for temporarily con-

trolling the hemorrhage until, if necessary, more effective measures can be carried out. Care should be taken not to wound the anterior pillar of the fauces, as it contains a small artery which when wounded gives rise to troublesome bleeding. Therefore, when the anterior pillar is adherent to the tonsil it should be carefully separated from it by means of a probe and Abraham's knife. When from any cause it is undesirable to use the tonsillotome, the wire snare of Peters can sometimes be used to advantage. Scirrhous tonsils should not be removed with the tonsillotome, as, owing to the canalicularization of the blood-vessels, a wounded artery cannot contract, and the hemorrhage is usually long continued and may be profuse and alarming. Hence, hard tonsils are most safely removed by means of the Peters snare or the galvano-cautery snare. The hot wire severs the tonsil almost as quickly as the tonsillotome, but leaves a burned surface that is painful and somewhat slow to heal.

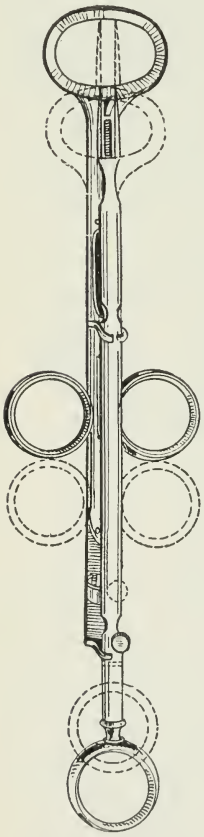


FIG. 128.—Ermold's tonsillotome.

Should an artery be observed to spurt after an operation upon the tonsils, the bleeding spot should be pierced with a tenaculum, by twisting which a sufficient amount of torsion can usually be made upon the tissues to stop the hemorrhage, or the artery can usually be seized by long-bladed hemostatic forceps and the bleeding stopped by compression or torsion.

In cases of long-continued oozing of blood from the cut surface of the tonsil, Formula 22 may frequently be used with success to control it, or the solid stick of nitrate of silver may be rubbed over the bleeding surface.

The *operation for removing the tonsils with the tonsillotome* is performed as follows: The patient, if a child, should be

seated in the lap of an assistant, who holds the child's legs between his own to prevent struggling. The assistant then passes his arms under the child's arms and grasps the child's forehead with his two hands in such a manner as to control the movements of the child's head. When the assistant elevates his elbows the child's arms are extended in such a manner as to prevent the child reaching his face with his hands and interfering with the operation.

The tonsillotome is introduced into the child's mouth flatwise, like a tongue-depressor, and serves to hold down the root of the tongue and afford a good view of the lower border of the tonsil. The ring of the tonsillotome is now passed around the tonsil from below in order to be sure that the lower border of the tonsil is encircled by the ring, which is pressed firmly against the wall of the pharynx. The blades of the instrument are now closed and tonsillotome and tonsil removed together from the mouth. If the operator is provided with two tonsillotomes it is generally feasible to remove the second tonsil before releasing the child, unless bleeding is excessive to a degree to interfere with a view of the fauces.

The operator should be provided with a set of at least three tonsillotomes, in order that he may select one with a ring of just sufficient size to snugly fit around the tonsil to be removed. After encircling the tonsil the instrument should be closed somewhat deliberately, and the operator should be careful to make no effort to remove the tonsillotome from the mouth until the tonsil has been completely severed. It should be borne in mind that the tonsils are not very sensitive. Indeed, they can be touched with the red-hot cautery-knife without causing much pain. The operation, therefore, is not especially painful, and probably causes less discomfort to the patient than the administration of ether, which, of course, if used adds an increased risk to the operation. However, there is no great objection to administering ether for tonsillotomy. Under such circumstances the tonsils are removed with the child's head turned to one side and hanging over the end of the table, to prevent as far as possible the flow of blood into the larynx.

The operation with the *galvanocautery* is performed in the following manner: A small galvanocautery-knife is introduced (cold) into one of the crypts of the tonsils and, being heated while *in situ*, is made to burn its way out. Two or three such burns may be made at a sitting upon a tonsil, and will be followed by considerable shrinking of the hypertrophied gland. But one of the tonsils should be operated upon with the galvanocautery at any one time, and from five to fifteen such operations are required to reduce the gland to satisfactory dimensions.

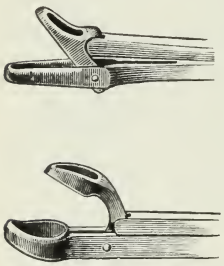


FIG. 129.—Myles' tonsil punches.

When it is necessary to operate under ether, the tonsils can sometimes be removed with less hemorrhage by means of a *snare* than by the tonsillotome. For this purpose Peters' tonsil snare is the most useful instrument; as by means of the powerful leverage afforded by this instrument the wire severs the tonsil almost as rapidly as the knife of a

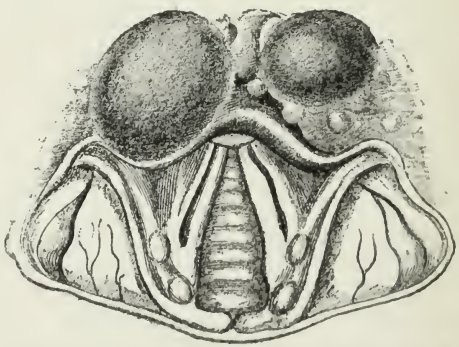


FIG. 130.—Reflex spasm of the glottis, caused by a large hypertrophy of the lingual tonsil (Rice).

tonsillotome. The wire loop is made to encircle the tonsil, which is then drawn out of the space between the pillars by means of Kirkpatrick's tonsil tenaculum forceps. The wire loop is pressed firmly against the pharyngeal wall as

the tonsil is pulled out through it by the forceps, and finally encircles the base of the tonsil so that as the loop is tightened the tonsil is completely enucleated from its bed. Hemorrhage is controlled by packing a strip of iodoform gauze into the space between the anterior and posterior pillars from which the tonsil was removed.

Sometimes in the case of bleeders and others it is desirable to remove the tonsil piecemeal. For this purpose one of the so-called tonsil punches (Fig. 129) may be used.

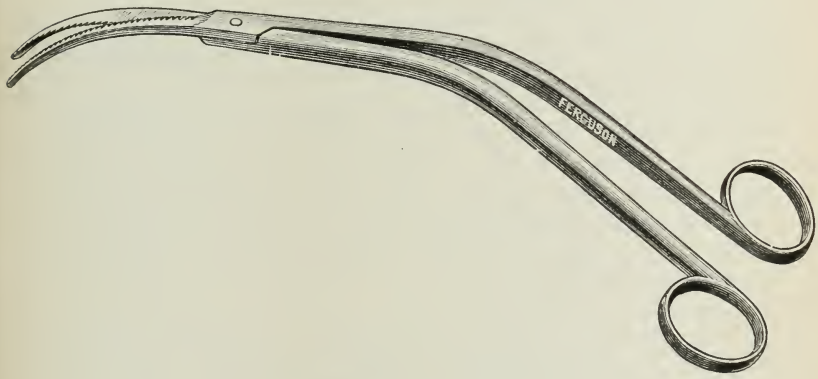


FIG. 131.—Kirkpatrick's lingual tonsil scissors.

Hypertrophy of the Lingual Tonsil.—Occasionally the mass of adenoid tissue at the base of the tongue becomes sufficiently hypertrophied (Fig. 130) to cause a reflex cough. Under such circumstances the redundant tissue may be cut away by means of Kirkpatrick's scissors (Fig. 131). The serrated edges of the instrument do not allow the flabby tissues to slip, while the curve of the blades is such as to fit the base of the tongue.

DISEASES OF THE UVULA

Inflammation of the uvula may occur primarily or as the result of extension of inflammation from the tonsils or palate. Occasionally it becomes edematous. The distention may be so great as to produce dyspnea. The treat-

ment consists in cocainizing the uvula, seizing it with a pair of mouse-tooth forceps, and freely incising the mucous membrane in a number of places in order to allow the fluid to escape. The same object may be accomplished sometimes more conveniently by snipping off the mucous membrane at the tip of the uvula.

Pseudomembranous Uvulitis.—The extension of a pseudomembrane from the tonsils to the uvula is somewhat characteristic of diphtheria. However, this occurs in other forms of pseudomembranous pharyngitis.

Treatment of Inflammation of the Uvula.—As inflammation of the uvula generally is only part of an inflammation involving the rest of the fauces, it is best to begin treatment by spraying the fauces with a 1 : 1000 solution of adrenalin ; the uvula should then be painted with a 10 per cent. solution of nitrate of silver. This should be done in the physician's office once or twice a day, the patient in the intervals either spraying his fauces every two or three hours with a 1 : 10,000 solution of adrenalin or a 3 per cent. solution of alumnol.

Ulceration of the Uvula.—The uvula sometimes becomes ulcerated as the result of traumatism and infection. Syphilis, lupus, or tuberculosis may be primarily located in the uvula. The uvula is sometimes destroyed by an ulcerating gumma. Occasionally these cases are first seen by the laryngologist when the ulcer has made considerable progress and the uvula hangs, as it were, by a string of mucous membrane. Under these circumstances the uvula sometimes can be saved by the daily subcutaneous injection of bichlorid of mercury (Formula 76), which, although painful, probably yields quicker results than other methods of treatment. Where an increasing gumma involves the posterior wall of the pharynx as well as the uvula and soft palate, there is great danger of cicatricial adhesions occurring that may entirely shut off communication between the posterior naris and oropharynx.

Deformities of the Uvula.—*Bifid Uvula.*—The uvula when present is always bifid in cleft palate as the result of the same cause that produces the palate deformity. Hence, ordinary bifid uvula might be considered as an incomplete

cleft palate. The deformity varies from a little dent at the free extremity of the uvula, which is usually club shaped, to a complete division separating the uvula into two lateral halves.

Treatment.—Bifid uvula, when it causes no symptoms, is best let alone. However, the parts may be freshened by means of a V-shaped incision and sewed together. If the uvula is thoroughly cocainized and then sprayed with adrenalin the operation is both painless and bloodless. For anesthetizing the uvula simply painting the parts with a 10 per cent. solution of cocain is not sufficient. The operator should be provided with a small cup at the end of a long handle. This is partly filled with a 4 per cent. solution of cocain and held under the palate in such a manner that the uvula soaks in the cocain solution for a few moments before the operation.

Elongation of the Uvula.—The whole mass of the uvula may be hypertrophied. More frequently, however, merely the mucous membrane is relaxed and hangs as a conic tip below the uvula proper. In rare cases a warty growth is attached to the end of the elongated uvula.

Etiology.—It is generally the result of chronic pharyngitis, the constant hawking to dislodge masses of mucus from the pharynx having a tendency to cause the affection. Paralysis of the palate is a reflex sometimes observed in ethmoiditis, and in such cases paralysis of the azygos uvulæ muscles and consequent elongation of the uvula are concomitant with the affection.

Symptoms.—Patients complain of "a tickling in their throats." The elongated uvula hanging in contact with the base of the tongue causes an almost constant short cough as an effort to dislodge a supposed foreign substance. These efforts are sometimes persisted in until nausea and vomiting result. Snoring is usually marked and the sleep is disturbed by dreams.

Treatment.—The redundant portion of the uvula should be amputated. This is ordinarily only relaxed and redundant mucous membrane at the tip of the uvula. It is rarely or never necessary to remove any of the muscular structure of the organ, and amputation of the entire uvula

close up to the soft palate is done only for the removal of malignant disease or as the result of the ignorance or awkwardness of the operator. The operation is perhaps best done in the following manner: The uvula is grasped at a point just below where it is decided to amputate with a pair of long hemostats, which are then clamped. The position of the hemostat marks the spot on the uvula where it has been decided to amputate; so that there is no danger of cutting off too much or too little. The uvula is stretched well forward and cut off close to the forceps by a single cut of a pair of somewhat heavy scissors, curved upon the flat, and held with their concavity upward in such a manner that the uvula is cut somewhat obliquely upward; and the wound, being upon the posterior surface, is protected from contact with food during the healing process. Generally there is but little inflammatory reaction and the wound heals promptly, but occasionally a mild acute pharyngitis occurs as the result of the operation when the uvula is thick and fleshy.

THE LARYNX

ANATOMY OF THE LARYNX

The larynx is an expansion of the upper portion of the trachea, so that there is formed a musculo-cartilaginous-membranous box constituting the essential organ of voice. It lies in front of the pharynx, of which it, with the base of the tongue, forms the lower anterior wall. Its superior aperture slopes downward and backward toward the pharynx and is partly closed from before backward during deglutition by a leaf-shaped lid, the *epiglottis*. The larynx is connected by ligaments and muscles with the surrounding tissues, the muscles serving to draw it upward during vocalization and deglutition.

Cartilages.—The cartilages of the larynx are nine in number, three single and three in pairs: The thyroid, cricoid, and epiglottic cartilages, the arytenoid cartilages, the cartilages of Wrisberg, and those of Santorini. The shapes of these, their relative size, and their manner of articulation and relative position to the hyoid bone is shown in Figs. 132 and 133.

The *thyroid cartilage*, so called from its resemblance in shape to a shield, is composed of two plates or wings, united in front at an angle in such a manner as to project forward beneath the skin of the throat as an elevation—the "Adam's apple." To its outer surface are attached the sternothyroid, thyrohyoid, and inferior constrictor muscles. To its inner surface are attached the epiglottis, the thyro-arytenoid, thyro-epiglottidean muscles, and the true and false vocal cords. The superior border of the cartilage curves backward from a median notch to the superior cornua or horns. To this border is attached the thyrohyoid membrane or ligament (Figs. 132, 133). The lower border gives attachment to the cricothyroid mem-

brane or ligament in the median line, and on each side to the cricothyroid muscles (Figs. 134, 135). The posterior borders and superior and inferior horns give attachment to the stylo- and palatopharyngeus muscles. To the apices of the superior cornua is attached the thyrohyoid ligament. The inferior cornua articulate with the cricoid cartilage.

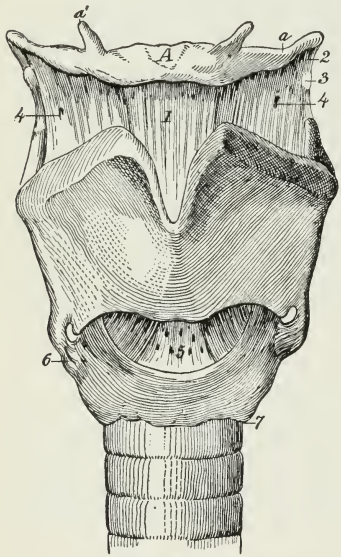


FIG. 132.—Articulations and ligaments of the larynx, anterior view: *A*, Hyoid bone, with *a* its greater, and *a'* its lesser cornua; 1–5, ligaments; 6, lateral cricothyroid articulation; 7, junction of cricoid and trachea. (Testut.)

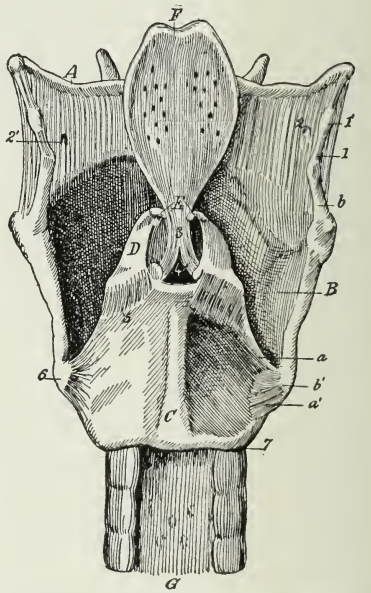


FIG. 133.—Articulations and ligaments of the larynx, posterior view: *A*, Hyoid; *B*, thyroid, with *b* and *b'* its cornua; *C*, cricoid; *D*, arytenoids; *E*, cartilages of Santorini; *F*, epiglottis; *G*, trachea; 1–6, ligaments; 2, opening for superior laryngeal artery; 7, junction of trachea and cricoid. (Testut.)

The *cricoid cartilage*, so called from its seal-ring shape, lies below the cricoid with its seal or broad surface posteriorly; laterally it articulates with the inferior cornua of the thyroid by means of small articular facets, and on the superior border posteriorly are two other facets for articulation with the arytenoid cartilages. To its lateral surfaces are attached the crico-arytenoideus posticus muscles and the longitudinal fibers of the esophagus (Figs. 134, 135).

To its upper border are attached the cricothyroid membrane and the crico-arytenoidei lateralis muscles; to its lower border a fibrous membrane connecting it with the upper ring of the trachea.

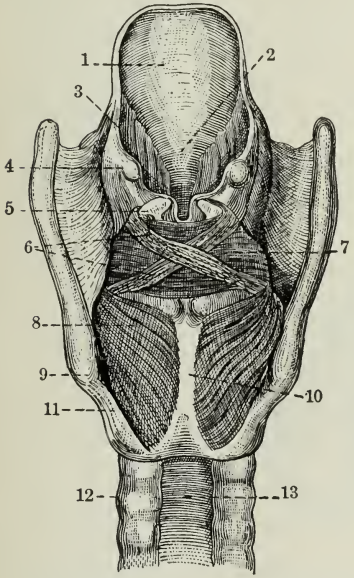


FIG. 134.—Larynx with its muscles, posterior view: 1, Epiglottis; 2, cushion; 3, aryepiglottic ligament; 4, cartilage of Wrisberg; 5, cartilage of Santorini; 6, oblique arytenoid muscles; 7, transverse arytenoid muscle; 8, posterior crico-arytenoid muscle; 9, inferior cornu of thyroid cartilage; 10, cricoid cartilage; 11, posterior inferior ceratocricoid ligament; 12, cartilaginous portion; 13, membranous portion of trachea. (Stoerk.)

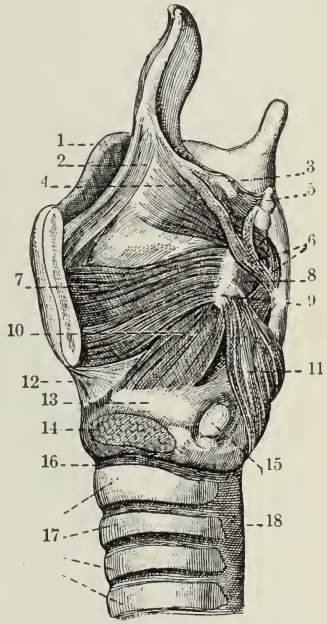


FIG. 135.—Larynx and its lateral muscles after removal of the left plate of the thyroid cartilage: 1, Thyroid cartilage; 2, thyro-epiglottic muscle; 3, cartilage of Wrisberg; 4, aryepiglottic muscle; 5, cartilage of Santorini; 6, oblique arytenoid muscles; 7, thyro-arytenoid muscle; 8, transverse arytenoid muscle; 9, processus muscularis of arytenoid cartilages; 10, lateral crico-arytenoid muscle; 11, posterior crico-arytenoid muscle; 12, cricothyroid membrane; 13, cricoid cartilage; 14, attachment of cricothyroid muscle; 15, articular surface for the inferior cornua of the thyroid cartilage; 16, cricotracheal ligament; 17, cartilages of trachea; 18, membranous part of trachea. (Stoerk.)

The *arytenoid*, or "pitcher-shaped" cartilages, articulate with the upper posterior border of the cricoid (Figs. 132–135). To the anterior surface are attached the false vocal cords and thyro-arytenoideus muscles; at the anterior angle

or *vocal process* are attached the true vocal cords and the thyro-arytenoideus muscles. To the posterior surface is attached the arytenoideus muscle. To the posterior angle, or processus muscularis (Fig. 137), are attached the crico-arytenoideus lateralis and posticus muscles (Figs. 134, 135). The median surfaces of the arytenoid cartilages are covered with mucous membrane and face each other; their apices articulate with the cartilages of Santorini.

Cartilages of Santorini are two small cartilages at the apices of the arytenoid cartilages, to which are attached the aryteno-epiglottidean folds.

Cartilages of Wrisberg are two little masses of cartilage contained in the aryteno-epiglottic folds.

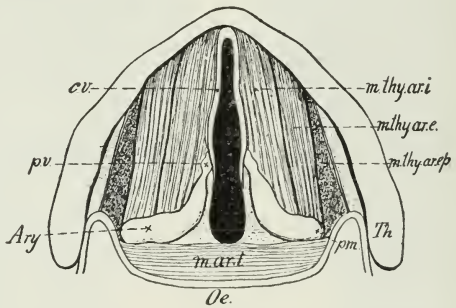


FIG. 136.—Diagram to illustrate the thyro-arytenoid muscles; the figure represents a transverse section of the larynx through the bases of the arytenoid cartilages: *Ary*, Arytenoid cartilage; *p.m.* processus muscularis; *p.v.* processus vocalis; *Th.* thyroid cartilage; *c.v.* vocal cords; *Oe* is placed in the esophagus; *m.thy.ar.i.* internal thyro-arytenoid muscle; *m thy.ar.e.* external thyro-arytenoid muscle; *m.thy ar.ep.* part of the thyro-aryepiglottic muscle, cut more or less transversely; *m.ar.t.* transverse arytenoid muscle. (Redrawn from Foster.)

Epiglottis.—The cartilage of the epiglottis is leaf shaped and attached by its apex to the thyroid's inner surface just below the median notch by the thyro-epiglottidean ligament (Figs. 132, 133). The epiglottic cartilage is covered by mucous membrane. Its base is free and points backward from the root of the tongue, to which its anterior surface is attached by three glosso-epiglottic folds of mucous membrane, and to the hyoid bone by the hyo-epiglottic ligament. The lateral margins are connected with the arytenoid cartilages by the aryteno-epiglottic folds. Its posterior surface

covers the superior aperture of the larynx when food passes down the pharynx.

Ligaments.—The larynx has nineteen ligaments—three extrinsic, binding the larynx to the hyoid bone, and sixteen intrinsic, binding its various cartilages together.

The *extrinsic ligaments* are the thyrohyoid membrane and two lateral ligaments (Figs. 132, 133).

The *intrinsic ligaments* are the cricothyroid membrane, the cricothyroid capsular ligaments (two), crico-arytenoid ligaments (two), crico-arytenoid capsular ligaments (two). In the false cords or ventricular bands the superior thyro-arytenoid ligaments (two). In the true vocal cords the inferior thyro-arytenoid ligaments (two), the hyo-epiglottic ligament, the thyro-epiglottic ligament, and the three glosso-epiglottic folds.

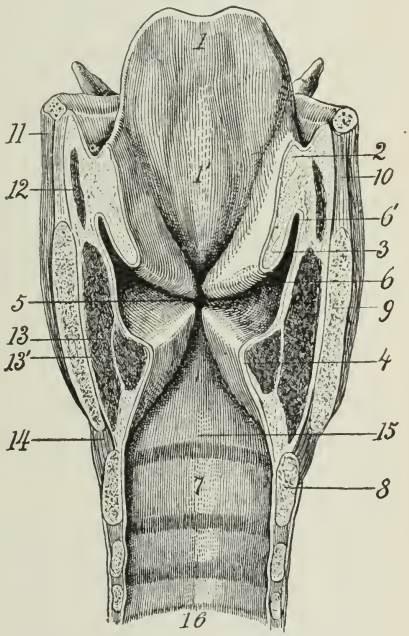


FIG. 137.—Vertical transverse section of the larynx: 1, Posterior face of epiglottis, with 1', its cushion; 2, aryteno-epiglottic fold; 3, ventricular band, or false vocal cord; 4, true vocal cord; 5, central fossa of Merkel; 6, ventricle of larynx, with 6', its ascending pouch; 7, anterior portion of cricoid; 8, section of cricoid; 9, thyroid, cut surface; 10, thyrohyoid membrane; 11, thyrohyoid muscle; 12, aryteno-epiglottic muscle; 13, thyro-arytenoid muscle, with 13', its inner division, contained in the vocal cord; 14, cricothyroid muscle; 15, subglottic portion of larynx; 16, cavity of the trachea. (After Testut.)

Muscles.—There are four pairs of lateral muscles and one central muscle, the *arytenoideus*, which extends from the posterior surface and outer border of one arytenoid cartilage to the corresponding parts of the other. There are both oblique and transverse fibers, and the action of the muscle is to draw the arytenoids together and close the posterior portion of the chink of the glottis (Fig. 134). It is supplied by both the superior and recurrent laryngeal nerves.

The four pairs of *lateral muscles* are:

The crico-arytenoideus lateralis, extending from the posterior angle of the base of the arytenoid to the upper lateral border of the cricoid cartilage. This muscle rotates the arytenoid inward and, with its fellow of the opposite side, closes the glottis except for the posterior portion, closed as described above by the action of the arytenoideus, bringing the bases of the arytenoid cartilages together. The lateral crico-arytenoids are supplied by the recurrent laryngeal nerve.

The cricothyroid, extending from the front and side of the cricoid cartilage to the lower and inner border of the thyroid (Fig. 136). The action of this muscle is to tilt the thyroid forward upon the cricoid and thus stretch and render tense the vocal cords. It is supplied by the superior laryngeal nerve.

The crico-arytenoideus posticus extends from the posterior angle of the base of the arytenoids to the posterior portion of the cricoid (Figs. 134, 135). Its action is to rotate the arytenoids outward and open the glottis while keeping the cords tense. It is supplied by the recurrent laryngeal nerve.

The thyro-arytenoideus extends from the angle of the thyroid cartilage and the posterior surface of the cricothyroid membrane into the base and anterior surface of the arytenoid (Fig. 137). Its action is to shorten and relax the vocal cords by bringing the thyroid and arytenoids closer together and to compress the sacculus laryngis. It is supplied by the recurrent laryngeal nerve.

The action of the intrinsic muscles may be studied by reference to Fig. 136 and the other figures illustrating the anatomy of the muscles of the larynx. Briefly, the chink of the glottis is closed by the action of the arytenoideus and the crico-arytenoideus lateralis. The cords are tightened and made tense by the action of the cricothyroid. The cords are relaxed by the action of the thyro-arytenoideus and separated by the action of the crico-arytenoideus posticus. The study of the action of the muscles of the larynx may be also facilitated by inspecting the figures illustrating laryngeal paralysis (Figs. 154–161).

The *muscles of the epiglottis* are three double muscles, all supplied by the recurrent laryngeal nerves. Their action is to depress the epiglottis and compress the sacculus laryngis. The epiglottic muscles are the thyro-epiglottideus, between the inner surface of the thyroid and the epiglottis and aryteno-epiglottic folds; the aryteno-epiglottideus superior, between the apices of the arytenoids to the aryteno-epiglottidean fold; and the aryteno-epiglottideus inferior, from the arytenoid cartilage just above the ventricular bands to the sacculus laryngis.

The **vocal cords**, sometimes called the *true* vocal cords in contradistinction to the *false* vocal cords or ventricular bands, extend anteroposteriorly across the larynx from the angle of the thyroid cartilage to the anterior angle of the arytenoids (Figs. 133–136). They each consist of a fold of mucous membrane containing the inferior thyro-arytenoideus ligament with the thyro-arytenoideus muscle parallel to it (Fig. 137).

The **ventricular bands** are two folds of mucous membrane containing the superior thyro-arytenoid ligament extending across the larynx above the ventricles of the larynx (Fig 137).

The **glottis**, or **rima glottidis**, sometimes called the chink of the glottis, is the space between the vocal cords. When the cords are separated during forced inspiration it is triangular in shape, with the apex of the triangle anterior. Its length rarely is 1 inch in the male, and its width posteriorly during inspiration does not exceed $\frac{1}{2}$ inch.

The **ventricles** of the larynx are oval depressions between the ventricular bands and the cords leading upward toward the sacculus laryngis.

The **sacculus laryngis** is the upper portion of the ventricle of the larynx. It contains sixty or seventy small mucous glands, whose secretion lubricates the cords. It is of conic shape and is covered by the aryepiglottideus inferior muscle medianly and the thyro-epiglottic muscle laterally. Both muscles by their action compress it and expel its contents (Fig. 137).

The **mucous membrane** of the larynx is somewhat thin. It is covered with ciliated columnar epithelium below the

level of the ventricular bands, extending up in front as high as the center of the epiglottis. Over the rest of the mucous membrane of the larynx is stratified squamous epithelium.

The abrupt change in the character of the epithelium of the larynx probably accounts for the rarity of infection of the pharynx extending into the lower air-passages; as it is a well-established fact that infections of mucous membranes generally respect anatomic boundaries when the character of the epithelium covering suddenly changes.

The **arteries** of the larynx are the laryngeal branches of the superior and inferior thyroid. The most important of these from an operative standpoint is the cricothyroid, which extends transversely across the cricothyroid membrane to anastomose with its fellow of the opposite side. This artery is seldom large enough to require ligation in deliberate operating. However, in emergency cases, where it is necessary to open the cricothyroid membrane as quickly as possible, it is better to cut the cricothyroid membrane transversely in order to avoid wounding this vessel.

The **veins** empty into the superior, middle, and inferior thyroid veins. Ordinarily these are vessels of small size, but in obstructed respiration from stenosis their size is greatly increased.

The **nerves** of the larynx are the superior and recurrent branches of the pneumogastric joined by branches of the spinal accessory and the sympathetic. The superior laryngeal is mainly a nerve of sensation. It enters the larynx through an opening in the thyrohyoid membrane and supplies the mucous membrane, the cricothyroid, and arytenoideus muscles.

The recurrent laryngeal is a motor nerve. It winds from before backward around the subclavian artery on the right side and around the arch of the aorta on the left side, and supplies all the laryngeal muscles *except* the *cricothyroid*. In its course it gives off cardiac, esophageal, tracheal, and pharyngeal filaments. It anastomoses with the superior laryngeal.

Aneurism of the aorta or subclavian pressing on the recurrent laryngeal nerve produces characteristic paralysis of the laryngeal muscles, and the same is true of hypertrophied

or tubercular lymphatics in the mediastinum or in the neck.

The **size of the larynx** varies greatly, being much larger in males than in females and children. At the age of puberty in boys the voice undergoes a rapid change in character and pitch. During this period of change the mucous membrane of the larynx is usually at least somewhat congested, and occasionally individuals are unable to control the pitch of their voices to the extent that they will begin a sentence in a high-pitched voice and end it in a bass voice or the reverse.

Musical notes used in singing have a range of about $3\frac{1}{4}$ octaves, and voices are classified according to their position in the musical scale into soprano, mezzosoprano, contralto, tenor, baritone, and bass. Soprano, mezzosoprano, and contralto voices are usually found in women, while the male voice is usually either tenor, baritone, or bass. *Voice production* is the result of the vibration of the vocal cords amplified by the resonant cavities above; that is, the pharynx, the mouth, the nose; in the same manner that the sound of a tuning-fork is amplified and made many times louder by approaching the vibrating fork toward the opening in a wide-mouthed bottle of a sufficient depth to contain a column of air capable of vibration in unison with the fork. The sound produced by the vibrations of the vocal cords is feeble and practically inaudible until it is amplified and made loud by the vibration of the air in the mouth, pharynx, and nose. The size of this cavity can be greatly reduced by the contraction of the palate, shutting off the cavity of the nose and nasopharynx from the space below, and the size and shape of the cavity of the mouth and oropharynx can be changed by the action of the muscles of the tongue and pharynx; so that it is possible to produce a space containing a volume of air capable of vibrating in unison with and amplifying a sound of any pitch produced by the vibration of the vocal cords. The larynx possesses the characteristics of both reed and string musical instruments. The *pitch* of a sound produced by the vibration of the vocal cords depends upon their length, thickness, and tension. What is called the *falsetto voice* is

the result of the cords vibrating not as a whole, but in two or more segments. The resulting sound is high pitched, far above the natural range of the individual's voice, and possessing a timbre or character usually disagreeable. Voices differ greatly in *range*, that is, some individuals have no more than a few notes of the musical scale, while others have 2 and even $2\frac{1}{4}$ octaves at their command, and above the natural range of their voices a falsetto voice, also of considerable range.

Musical notes (see p. 237) have three qualities—*loudness*, *pitch*, and *timbre* or character. We have already learned how loudness of voice is the result of the amplification of the sound produced by the resonant cavities of the mouth, pharynx, and nose. The loudness also is dependent on the force and amplitude of the vibrations of the vocal cords.

The *timbre* or character of the voice is as varied as the dispositions of individuals. It is that quality by which we recognize the voice of an individual as different from all other individuals. In singers the timbre of the voice may be sweet and pleasant or rough, coarse, and unpleasant. It may be nasal, from the presence of adenoids or other growths that render the use of the nose as a resonant cavity impossible. Timbre of the voice is probably the result of the relative size and shape of the resonant cavities, the position of the teeth and lips, and the thousand and one anatomic peculiarities of an individual's vocal organs. In this connection it is well enough to insert a word of caution as to the impropriety of suddenly greatly altering the size or shape of the upper respiratory tract, as, for example, by the ablation of very greatly hypertrophied tonsils in the case of professional singers, for fear that the character of their voice may be changed for the worse rather than the better.

The *singing voice* differs from the speaking voice mainly that in singing the tone is sustained at the same pitch for an appreciable length of time, while in speaking the voice is continually sliding up and down the musical scale on the vowel sounds.

DISEASES OF THE LARYNX

Anemia.—The presence of laryngeal anemia is of especial importance: (1) When associated with functional aphonia. (2) When, during the course of an attack of chronic laryngitis, the mucous membrane covering the aryepiglottic folds, arytenoid cartilages, and ventricular bands is abnormally pale while the vocal cords are the seat of indolent congestion, the patient not being generally anemic. Each of the above conditions are premonitory of laryngeal phthisis.

Hyperemia of the larynx is a congestion of the mucous membrane of the larynx, most marked where the submucosa is loose, fat, and thick, as upon the aryepiglottic folds, ventricular bands, and ventricles; the epiglottis, vocal cords, and inferior cavity of the larynx being but little altered in color. Its presence renders an individual more prone to contract acute or chronic laryngitis.

Etiology.—Hyperemia of the larynx is oftenest the result of excessive smoking, especially of cigarette smoking. It also results from working in dusty rooms and amid irritating chemic fumes.

Acute laryngitis is an acute inflammation of the mucous membrane of the larynx, sometimes extending to the submucous tissue and muscles.

Synonyms.—Acute mucous laryngitis; acute catarrhal laryngitis.

Etiology.—Acute laryngitis is generally the result of exposure to wet and cold, the same causes that produce an ordinary coryza, acute laryngitis being in many instances simply an extension of the disease downward. Many individuals have an hereditary or acquired tendency toward laryngeal inflammations. The affection also occurs as a complication in measles, variola, scarlatina, typhoid, rötheln, and chicken-pox, and also as the result of traumatism, such as the inhalation of steam or irritating vapors. When acute laryngitis results from traumatism, the inflammation frequently assumes the edematous form of the disease, as the result of the submucous tissues being involved, while in children the croupous form is frequently met with, the

mucous membrane of the larynx being covered with false membrane.

Symptoms.—The voice is altered in almost all cases, becoming in some almost aphonic, and its use extremely fatiguing and sometimes painful. In adults the respiration is generally unembarrassed, embarrassed respiration indicating that the inflammation is assuming the more serious character of edema. In children, on the contrary, embarrassed respiration is often the first symptom of the attack, the embarrassed respiration quickly assuming the spasmodic character of croup. The expectoration in adults is at first clear, frothy, mucopurulent, but somewhat scanty, abundant expectoration indicating that the disease has extended to the bronchi. Expectoration in children being always very scanty probably explains why the paroxysms of dyspnea

FIG. 138.—Laryngitis involving chiefly the false cords as the cause of false croup (Frühwald).

FIG. 139.—Swelling below the vocal cords from laryngitis hypoglottica chronica (after Ziemssen).

are so severe and prolonged, the pain, tickling, and sense of tightness in the throat being in them more severe. The color of the mucous membrane of the larynx as seen in the laryngoscope is always heightened, but varies in different parts of the larynx and according to the degree of the inflammation, the cords in slight attacks being quite white, while in severe attacks they are so red as to be scarcely distinguished from the surrounding parts. The ventricular bands are also sometimes so swollen as to entirely cover the vocal cords or the cords may be prevented from approximation by swelling of the posterior glottic commissure.

Treatment.—It is well to begin with the administration of a saline cathartic. The patient should remain in a warm room, avoid using his voice, and draw into his larynx every

two hours the spray from an atomizer containing a 1 : 10,000 solution of adrenalin. This is readily done by the patient inserting the nozzle of an atomizer in his mouth and inhaling deeply as he presses the bulb of the atomizer. The patient will feel the spray enter his larynx and should continue the use of the atomizer until the laryngeal mucous membrane is well covered by the spray. An application should be made to the interior of the larynx once or twice each day of a sedative and slightly astringent powder (Formula 59) by means of a powder-blower (Fig. 45). In making such an application to the interior of the larynx the patient is requested to grasp the tip of his tongue with a napkin and hold the tongue well forward. The operator, holding the laryngeal mirror in his left hand, introduces the mirror into the fauces in such a manner that he sees the reflected image of the glottis. The powder-blower should be held in the operator's right hand, and its nozzle is placed in the pharynx in such a position that it is seen reflected in the laryngeal mirror, and moved until it is observed to point toward the glottis. The patient is requested to say "a," and at the same instant the powder should be blown from the powder-blower into the larynx. When an individual says "a" or, indeed, makes any other sound with his vocal organs, the cords are brought together in order to produce it, so that any application made at that instant is limited to that part of the larynx above the cords. Should it be deemed necessary to apply the powder to the larynx below the cords, it may be accomplished by using the powder-blower while the patient holds his breath, or the powder may be carried deep into the bronchi if the powder-blower be used while the patient is inspiring. After the more acute stage of the disease has passed, Formula 57 or even 56 should be used instead of Formula 59 as an application to the interior of the larynx. In the more severe cases powders of any kind are not well borne, and under such circumstances sprays of cocain, adrenalin, and menthol-camphor-albolene should be employed.

The application of cold or heat to the skin over the larynx gives decided relief in the more severe cases. As to the selection of heat or cold the sensations of the patient would

seem to be the best guide. In the writer's experience heat is usually the more grateful. Cold may be applied by means of a Leiter coil, a small ice-bag, or a napkin wrung out of ice-water and applied to the neck over the larynx. It should be changed sufficiently often to maintain the degree of cold desired.

Heat may be utilized by applying a Leiter coil upon the skin over the larynx in the usual manner and allowing hot water to flow through the coil. A folded napkin should be placed under the coil to protect the skin, and the temperature of the water should be as high as can be borne comfortably by the patient.

The more severe forms of acute laryngitis, fortunately rare, will require careful watching, and the physician should be prepared to prevent suffocation from edema by scarifying the epiglottis or, if necessary, by intubation or tracheotomy.

Subacute laryngitis is an inflammation of the mucous membrane of the larynx subacute in character.

Etiology.—Subacute laryngitis commonly results from the same causes as the acute form of the disease. It generally attacks individuals of feeble constitution or it may result from neglecting to treat properly the acute affection. Usually slight dyspnea and hoarseness are prominent symptoms. The former, generally worse at night, sometimes occasions the patient alarm. Feeble individuals, especially children who spend most of their lives indoors, are more liable to attacks of this disease than the robust and those who are much outdoors. A frequent predisposing cause is the admixture of the products of combustion with the hot air supplied from furnaces. A careful supervision of the workman each fall when the furnace is put in order for the winter, to make sure that the parts of the fire-box are fitted too tightly to allow of any escape of carbon-dioxid gas into the hot-air chamber, will sometimes prevent every member of the household suffering from recurrent attacks of sore throat during the entire winter.

Dusty occupations and the frequent inhalation of irritating fumes produce chronic laryngitis and acute exacerbations of the inflammation. By far the most common cause is exposure to cold. However, it is not usually normal res-

piration of cold air that is responsible for attacks of acute laryngitis, because as long as the nose is normal the air inspired through it is moistened and its temperature raised sufficiently to render it harmless to the larynx. This is not the case in individuals whose noses are sufficiently abnormal to necessitate mouth-breathing, and it is somewhat curious to note in this connection that during the first few years of a chronic nasal catarrh each cold is essentially nasal; but in the later stages of the disease the brunt of such attacks is borne by the larynx and trachea. This is probably not due to an extension of the catarrhal disease by continuity of surface, but to increasing hypertrophy of the turbinated bodies, rendering the individual a mouth-breather as soon as he inhales cold air. It is not the inspiration of cold air that always is responsible for an attack of acute laryngitis. Most individuals take cold through their feet. The ground is a better conductor of heat than the atmosphere and therefore the soles of the shoes should be of heavy material. The shoes should be loose about the ankles so as not to impede the circulation, and so constructed as not to prevent the evaporation of moisture. A dentist friend and patient informed me that he suffered for years with cold feet until he adopted the plan of wearing low shoes the entire year. During the winter his woolen underdrawers were made long enough to extend over the ankles and protect them. He wore cotton or light wool stockings.

Treatment.—The treatment is similar to that of acute laryngitis. A most important part of the treatment of acute laryngitis is rest, especially of the inflamed larynx. All unnecessary talking should be avoided and no effort made to talk above a whisper. In the case of singers, orators, and actors, where it is of the utmost importance that a normal voice should be regained as speedily as possible, absolute rest in bed in a warm room will do much to hasten the desired result; $\frac{1}{3}$ gr. of calomel with 5 gr. of bicarbonate of sodium should be given every hour until six doses have been taken or the bowels freely moved. If the attack is of sufficient severity to cause some elevation of temperature and a hot, dry skin, 1-drop doses of tincture of aconite root should be given every fifteen minutes until three or four doses have

been taken, and then every hour until the skin has become moist. Of the other internal remedies, yerba santa usually yields the most speedy and satisfactory results, especially in cases unaccompanied by fever and a hot, dry skin. A pill containing 1 or 2 gr. of the extract combined with $\frac{1}{100}$ gr. of strychnin should be given every two hours, or the patient may take half a teaspoonful of malto-yerbine every one or two hours. The patient should inhale the spray from an atomizer containing a 1 : 10,000 solution of adrenalin every one or two hours.

Both cocain and antipyrin have sedative and astringent effects upon the inflamed mucous membrane of the larynx. The application of the former gives relief for only half an hour, and is followed by increased congestion. The effect of cocain can be maintained by frequent instillation of the drug or by following its use by a spray of antipyrin, which will maintain the local sedative effects of the cocain in many instances for from two to four hours.

After the more acute stages of the disease have passed, and in the milder attacks of hoarseness affecting singers, astringents yield better results than adrenalin, and the spray from an atomizer containing a 2 to 4 per cent. solution of alumnol may be inhaled by the patient every hour or two with decided advantage. In singers and actors with slight laryngitis the neurotic element plays an important part, and voice-failure when on the stage is largely due to nervousness and fear. Under such circumstances a pill containing $\frac{1}{20}$ gr. of strychnin or a teaspoonful of the fluidextract of coca in a glass of sherry wine, taken immediately before the curtain rises, will do much to secure a satisfactory control of the voice during the performance.

Chronic laryngitis is a chronic inflammation of the mucous membrane of the larynx.

Etiology.—It is generally the result of faulty use of the voice by singers or public speakers, and also of excessive smoking, especially cigarette smoking. The smoking of cigarettes is particularly injurious, not on account of the paper wrappers or any peculiarity of tobacco, but from the habit all cigarette smokers soon acquire of inhaling the smoke and bringing it directly into contact with the sensitive

mucous membrane of the larynx. It is the very "mildness" of the smoke from cigarettes, in comparison with cigar smoke or that of a pipe, that makes them more injurious. The convenience and cheapness of cigarettes also causes the cigarette smoker to light a cigarette whenever he has a few moments to spare and under circumstances when he would not think of smoking a cigar or a pipe, the ill effects of which are generally confined to the pharynx. Dusty occupations and the frequent drinking of undiluted distilled liquors are also causes of the disease, while the affection is sometimes simply the expression of the rheumatic diathesis. The presence of tumors inside the larynx usually are the result rather than the cause of chronic laryngitis.

Symptoms.—The voice, as a rule, is chronically hoarse, but the degree of hoarseness varies materially from time to time. In singers the injury to the voice will be manifested in loss of range, diminished endurance, and loss of control. As the disease advances all vocal efforts will be obviously strained and labored. Cough is by no means a constant symptom. The secretion is at no time very great in amount and diminishes as the disease advances. It is thick, starch-like, and tenacious. Small amounts of mucus frequently collect in the interarytenoid space and, being suddenly detached by coughing, are thrown out through the mouth to a considerable distance, while little bridges of mucus are sometimes seen with the laryngoscope extending from cord to cord in the larynx. There is a constant feeling of constriction, as of a foreign body in the air-passages. Upon inspection certain portions of the mucous membrane of the larynx appear redder than normal; and sometimes the entire mucous membrane of the larynx is of a uniform red color, with the exception of the cords, which may be somewhat lighter in color than the surrounding parts. The mobility of the cords is frequently impaired, either from swelling of the mucous membrane covering the arytenoids or from slight muscular pain. Erosion of the interarytenoid space is frequently seen.

Prognosis.—Recovery from chronic laryngitis is always slow, and depends upon the faithfulness with which the treatment is carried out.

Treatment.—Constitutional remedies, except in rheumatism of the larynx, are not of the greatest importance; but, as in every other chronic affection, the general health should be improved as much as possible. Local treatment should consist of the application by the patient several times a day to the affected mucous membrane of a sedative or astringent solution by means of the spray of an atomizer, a 4 per cent. solution of alumnol being especially useful for this purpose.

As an office treatment applications of argyrol (10 per cent.) twice a week sometimes yield excellent results, and the occasional application of nitrate of silver solution in obstinate cases is very beneficial. The use of the remedy requires some care, and a very little of the solution should be used until it is ascertained that its use is not followed by spasm of the glottis. Most larynxes will stand the application of a cotton-tipped applicator dripping with a solution of silver nitrate (10 gr. to 1 ounce), and solutions of 1 dram to 1 ounce can cautiously be employed. The unusually slight irritation produced by the application of even the stronger solutions sometimes lasts for several hours, but is followed by decided relief of hoarseness and congestion of the parts.

In the more severe cases pain, congestion, and hoarseness are sometimes quickly relieved by the insufflation of powdered orthoform or antipyrin. A milder astringent powder consists of 1 part alumnol and 2 parts milk-sugar. It may be used with good effect in all cases of chronic laryngeal congestion. Sulphate of zinc (from 15 gr. to 1 ounce of milk-sugar up to equal parts of sulphate of zinc and milk-sugar) yields good results in some cases.

Laryngitis Sicca.—In rare cases catarrh of the larynx results in an exhaustion of the fluid elements of the laryngeal secretion as the result of atrophy of the glandular elements of the mucous membrane. The disease is generally associated with atrophic rhinitis and pharyngitis.

Pathology.—The appearance of the laryngeal mucous membrane is similar to that of the nose and pharynx in atrophic rhinitis and pharyngitis. In some cases the parts are simply dry and glazed, looking as if varnished; in other cases there are accumulations of inspissated mucus,

often greenish in color and emitting an offensive odor similar to that observed in atrophic rhinitis. The gross structural alterations that are seen in the nose in atrophic rhinitis are not observed in atrophic laryngitis. It is a disease characterized by diminished and perverted secretions rather than by atrophy of mucous membrane, submucous structures, and laryngeal cartilage. The masses of inspissated secretions cling to portions of the larynx where the glands are most numerous—the subglottic region and the upper surface of the ventricular bands.

Symptoms.—In cases where there are no accumulations the larynx feels dry and irritated. The voice is slightly hoarse and tires upon the slightest exertion. In cases characterized by accumulation of fetid secretions the sufferings of the patient are mainly due to the irritation produced by the presence of these secretions and by the effort to rid himself of them. His strength is exhausted by ceaseless and useless coughing, usually worse at night. Occasionally a little mass will be ejected from the larynx with considerable violence, bringing with it a small area of laryngeal epithelium, and producing a slight capillary hemorrhage which alarms the patient. In the few cases which the writer has seen—for the disease is somewhat rare—the patients were fairly well nourished.

Treatment.—In cases where the disease is the result of atrophic rhinitis, efforts should be directed toward improving the condition of the nose, so that the important function of warming and moistening the inspired air is restored. The wearing of cylinders of absorbent cotton within the nose, as directed for the treatment of atrophic rhinitis, is also valuable in bringing about an improved condition of the laryngeal secretions.

Patients with atrophic rhinitis do well in a moist climate. In one case all laryngeal symptoms had disappeared upon the return of a patient to Philadelphia after a year's absence in the Philippines. Internally may be given stimulating expectorants or drugs, such as iodid of potassium and hydriodic acid, that increase the secretions of the upper respiratory tract and render them more fluid.

Inhalations of steam or the use of the bottle-inhaler with

hot water and tincture of benzoin aid greatly the patient's efforts to get rid of the annoying laryngeal accumulations. Great relief sometimes follows spraying the larynx with equal parts of hydrogen dioxid and Dobell's solution, because the action of the dioxid upon the accumulations softens them and increases their bulk, and hence aids their expulsion from the larynx. The irritation of the larynx is best controlled by spraying the parts with a 2 per cent. solution of antipyrin.

Inflammation of the Submucous Tissue of the Larynx.—Acute edema of the larynx usually is the result of phlegmonous inflammation with infiltration of the surrounding submucous tissue, frequently endangering life by occlusion of the rima glottis.

Synonyms.—Edematous laryngitis; phlegmonous laryngitis; acute edema of the larynx; edema of the glottis.

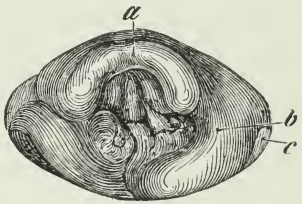


FIG. 140.—Phlegmonous laryngitis, with phthisic ulcer: *a*, Epiglottis; *b*, left aryepiglottic fold; *c*, left pyriform sinus. (From v. Ziemssen, after Türck.)

Etiology.—Edema of the glottis may result from traumatism, such as the swallowing of corrosive liquids. It occurs rarely as a primary affection, resulting from exposure to cold and wet in persons of debilitated constitution. In most instances, however, the disease is secondary, and results from syphilitic or tuberculous perichondritis (Fig. 140), retropharyngeal abscess, Bright's disease, glycosuria, etc.

Pathology.—The infiltration consists essentially of a serous or seropurulent fluid, most abundant beneath the mucous membrane of the aryepiglottic folds, the ventricular bands, and the ventricles. The submucous tissue is most abundant in these regions of the larynx, but the edema is not always limited to that part of the larynx above the vocal cords, but may extend to the submucosa beneath the

vocal cords. Infraglottic edema, as the disease is then called, is almost invariably secondary in its origin and always serous in character (Fig. 139).

Symptoms.—In some cases there are no symptoms whatever prior to a fatal suffocation or syncope. The voice is usually rough and deep or altogether lost, due to thickening and heaviness of the cords. In the early stages of an attack the chief difficulty in breathing is during inspiration, but, as the disease advances, expiratory distress occurs, with the result of producing complete apnea. A short cough is present and deglutition is both difficult and painful. When the edema is considerable the sense of suffocation is most oppressive. With the laryngoscope edema is quickly recognized; the infiltrated portion of the larynx being greatly swollen and semitransparent in appearance. When the edema is subglottic, the swollen mucous membrane of that region will almost always be seen of a more intense red than the cords above.

Prognosis.—Recovery from severe primary edema is always doubtful, and the prognosis in secondary edema depends upon the circumstances of the primary cause of the disease. The patient can hardly be said to be out of danger under two or three weeks from the commencement of an attack, and may even then become the subject of chronic infiltration. When death occurs it is almost always the result of carbonic-acid-poisoning, and may be the direct effect of stenosis or spasm of the glottis. Another danger is the possible occurrence of suppuration—abscess of the larynx.

Treatment.—Free diaphoresis should be produced in suitable cases by the hypodermic use of $\frac{1}{12}$ to $\frac{1}{4}$ gr. of pilocarpin. The temperature of the room in which the patient lies should be carefully regulated, and cold, dry applications kept upon the throat over the larynx. As soon as edema is seen within the larynx local scarification with the laryngeal lancet (Fig. 141) should be performed. If, in spite of scarification and the use of pilocarpin, edema continues with increasing respiratory distress, general enfeeblement, and symptoms of carbonic-acid-poisoning, intubation or tracheotomy should be performed

at once. Many lives probably have been sacrificed by hesitation and delay.

Laryngitis syphilitica is an inflammation of the larynx due to syphilis.

Synonyms.—Specific laryngitis; laryngeal syphilis; syphilis of the larynx.

Etiology.—Syphilis of the larynx most frequently occurs as a manifestation of the tertiary period, three to thirty years after the primary infection. As a manifestation of secondary syphilis laryngeal symptoms may occur within a few weeks or may not appear until two or three years after syphilis has been contracted.

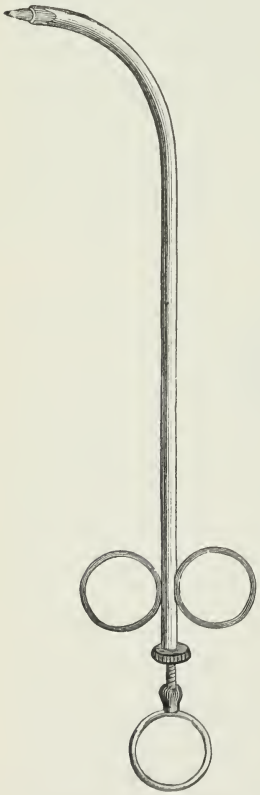


FIG. 141.—Tobold's laryngeal lancet.

Pathology.—In secondary syphilis the laryngeal symptoms may consist of a mere hyperemia, giving rise to the symptoms of simple laryngitis. Ulcerations may also be present and are usually symmetric, that is, if an ulcer is present upon one part of the larynx, there is usually a similar ulcer also upon the corresponding part of the opposite side of the larynx. Syphilitic warts or condylomata are also frequently found in the larynx during the secondary stage of syphilis. They may undergo ulceration or disappear spontaneously. Tertiary manifestation consists of gumma, which may break down and cause deep ulcerations, with perichondrosis and necrosis of the cartilages; while stenosis may result from cicatricial contraction after the healing of syphilitic ulcers.

Symptoms.—The patient usually first complains of a slight hacking cough, hoarseness, and sometimes difficult and painful deglutition. Inspection with the laryngoscope reveals some of the lesions already specified.

Treatment.—Constitutional remedies already mentioned (see Syphilitic Rhinitis) should be employed. Alumnol or some other astringent should be prescribed for the patient's use at home, in the same manner as for simple laryngitis, while an application of Formula 58 should be made to the interior of the larynx every other day with the powder-blower. If shallow ulcers are present they should be touched each day with the solid nitrate of silver melted on the end of a probe. This may be accomplished by melting a few crystals of the nitrate on a silver coin and dipping the end of a cold silver probe into it. Enough of the silver nitrate will adhere to the end of the probe to make one application. If, however, the ulcers are deep, such applications will not be sufficient to secure a speedy healing of the ulcers. They should then be touched by means of the cotton applicator every other day with the acid nitrate of mercury diluted with 5 parts of water, application of nitrate of silver being made on alternate days. After a time, when the process of repair is beginning to set in, these applications become painful and should be omitted,

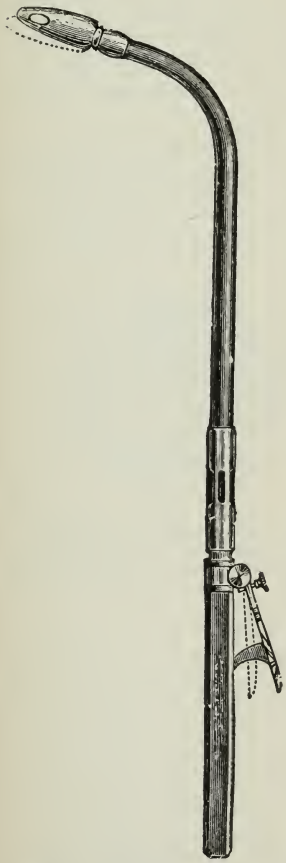


FIG. 142.—Browne's hollow laryngeal dilator with cutting blade (⅓ measurement).

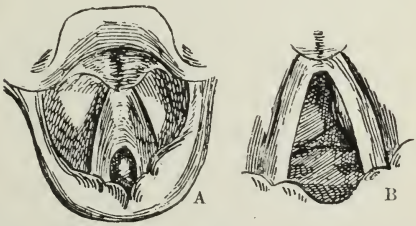


FIG. 143.—*A*, Cicatricial stenosis before treatment; *B*, the same after use of cutting dilator (Lennox Browne).

but insufflations of Formula 58 should be continued until the larynx presents its normal appearance. Should partial stenosis occur as the result of cicatricial contraction, the laryngeal stenosis may be overcome by the use of laryngeal bougies or some suitable cutting instrument (Fig. 142).

Tubercular Laryngitis.—Tubercular laryngitis is a chronic laryngitis due to the specific poison resulting from the presence of the tubercle bacilli. It is sometimes called laryngitis phthisica and throat consumption.

Etiology.—It is generally secondary to pneumonic phthisis, although this is a debatable question. In most all instances the cellular tissue of the larynx is the structure first affected. The inoculation in this locality may occur through the lymph-channels, the blood-vessels, or by means of an abrasion in the mucous membrane exposed to tubercular sputum from the lungs. Inoculation of tuberculosis in syphilitic ulcers in the larynx has been observed, and it is stated that the presence of simple catarrhal laryngitis, either acute or chronic, is a predisposing cause of tubercular laryngitis when tuberculosis of the lungs is already present. Hospital reports, mostly German, vary from 6 to 50 per cent. as to the frequency of laryngeal involvement in post mortems on individuals dead from pneumonic phthisis. Probably about one-third of the cases of lung consumption in this country, sooner or later, develop laryngeal lesions. That the larynx is not frequently inoculated by the inspiration of pulverized dried phthisic sputum is probably due to the fact that under ordinary circumstances particles of dust in inspired air are arrested within the nose or pharynx and do not reach the larynx; and in this connection it is interesting to note that certain observers have claimed that those suffering from atrophic rhinitis are proportionately more frequently attacked by pneumonic phthisis than those with normal noses. Most frequently tubercular lesions of the larynx occur on the same side as the lung most affected by the disease, although this is not invariably the case.

Pathology.—The lesions in the larynx are similar to those found in tuberculosis elsewhere: Tubercles are formed and the bacilli are disseminated into the surrounding tissues, partly by their own multiplication and partly by lymph-

currents, so that the extent of the tissue involvement is always much greater than it appears to the eye of the observer. As the result of nature's efforts to limit the spread of the infection, leukocytes appear about the affected area and a reticulum of connective tissue is formed. Degeneration of the tubercle then occurs as the result of lack of nutrition, and manifests itself either as a local sclerosis or as a tissue necrosis, with a resulting ulcer that may involve not only the mucous membrane and cellular tissue but also muscles and cartilages as well. Bacilli appear in the discharges and the tuberculous process extends.

In tuberculous individuals there is often observable an ashy gray appearance, differing from the ordinary paleness

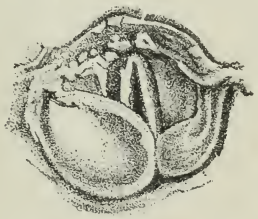


FIG. 144.—Laryngeal tuberculosis with characteristic pyriform swelling of the arytenoid cartilages (Lennox Browne).

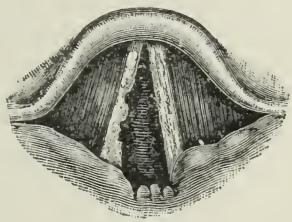


FIG. 145.—First stage of tuberculosis of larynx. Ulceration of right cord and swelling of interarytenoid region with formation of folds. May be early ulceration here (Sahli).

of anemia of mucous membranes at the junction of the hard and soft palate. The same color is also less frequently observable in the larynx. There is sometimes slight localized congestion of the cords, one of which may be partially paralyzed and sluggish in its movements from the pressure of a hypertrophied tuberculous lymphatic upon the recurrent laryngeal nerve. The voice under such circumstances is somewhat aphonic and perhaps slightly hoarse at times.

Characteristic lesions are submucous infiltrations, generally club-like in shape, sometimes involving one or both arytenoids, "pyriform arytenoids" (Fig. 144), or producing the "turbine-shaped" epiglottis. Minute tubercles break down upon the cords, producing ulcers that give the cords a "moth-eaten" appearance (Fig. 145). Fungus-like thicken-

ing of the interarytenoid mucous membrane is common in laryngeal tuberculosis. Deep ulcerations involving necrosing cartilage is a later stage, from which there are few recoveries. Usually the concomitant lung lesions have also reached an advanced stage, and the fatal end is hastened by the patient's inability to swallow or even breathe without pain.

Differential Diagnosis.—In certain cases the differential diagnosis between malignant ulceration and tuberculosis is one of extreme difficulty. In malignant ulceration the inflamed and reddened appearance of the unaffected mucous membrane of the larynx contrasts strongly with the pale and anemic appearance in tuberculosis. There is the lung involvement in tuberculosis, the greater involvement of the cervical glands in malignant disease. There are two other conditions of the larynx that sometimes closely simulate tuberculosis in appearance—syphilis and lupus.

It should be borne in mind that tuberculosis is sometimes engrafted upon a syphilitic ulcer. Syphilitic ulcer of the larynx follows the breaking down of a gumma. There is usually a history of syphilis or syphilitic lesions may be found upon the body elsewhere. The diagnosis will be cleared up by the administration of antisyphilitic remedies.

Lupus is tuberculosis of the larynx resulting from the inoculation of the larynx with an attenuated tubercle bacilli, is usually secondary to lupus of the mouth or pharynx, and is an extremely rare disease.

Symptoms.—In the earlier stages of the disease there are practically no symptoms except perhaps occasional transitory hoarseness or very slight aphonia. These voice symptoms increase as the disease progresses until the voice may be a mere whisper and very hoarse. The interference with vocalization may be due to pressure upon the recurrent laryngeal nerve, interarytenoid thickening interfering mechanically with the approximation of the cords, tubercular infiltration of the muscles or involvement of the arytenoid articulations or ulcerations upon the cords. Thick, tenacious mucus coughed up from the trachea or supplied by the larynx if ulcers are present may adhere for a time to the cords and interfere with vocalization until

dislodged. This usually occurs after several ineffectual efforts—the mass being expelled through the mouth with considerable force.

A hacking, dry cough is often present when there is interarytenoid thickening. When ulceration is present the secretions are more abundant and contain the tuberculous bacillus. The secretions are sometimes streaked with blood, but abundant hemorrhage from tubercular ulcerative laryngitis probably never occurs.

Pain on swallowing occurs where the infiltration of the arytenoids or epiglottis is great, and there is a sense of obstruction in deglutition as if from a "lump in the throat." Deglutition becomes exquisitely painful when ulceration has occurred upon the epiglottis or in the aryepiglottic fold. Ulceration within the larynx gives rise to little or no dysphagia and liquid gives rise to less pain than solid food. So exquisitely painful is the act of swallowing in some cases that patients have been known to refuse food or drink for days rather than endure the torture of swallowing it.

Prognosis.—Cures have been reported even in the ulcerative stage of the disease, but the progress of the disease in all cases is usually slow and tedious. Harland states that the chances of improvement in tuberculosis of the larynx are nearly as follows:

"1. Larynx free from disease; prognosis so far good. 2. Congestion of cords (vasomotor); prognosis good; examination of lungs indicated. 3. Superficial ulcer, localized infiltration or tuberculoma; chances of improvement about 60 per cent. 4. Deep ulceration; chances of improvement about 38 per cent. 5. Lesions of vocal cord, ventricular band, or interarytenoid fold; chances of improvement about 89 per cent. 6. Lesions of epiglottis or aryepiglottic fold; chances of improvement about 29 per cent."

Treatment.—The treatment of the milder forms of the disease should be largely systemic. It should be borne in mind that the disease only does great harm when it causes pain or prevents the taking of food, and that occasionally large ulcers have been seen to heal with practically no local treatment. Cutting operations with the expectation of eradicating the local disease are probably, in most cases,

worse than useless, as it is impossible to know how far the bacilli have penetrated the apparently sound tissue about a lesion. Of course, if tubercle papilloma in the interarytenoid or other regions attain such a size as to produce dyspnea, as they rarely do, an effort should be made to remove them with forceps or snare; otherwise those growths should be let alone. They frequently recur after removal.

Ulcerations should be cleansed with equal parts of Dobell's solution and peroxid of hydrogen by means of a spray from an atomizer. After the parts have been cleansed the ulceration should be dusted by means of a powder-blower with Formula 59.

Owing to the bulk of the tannic acid contained in this powder the amount of morphin in the quantity thrown by the powder-blower into the larynx is very minute, but if

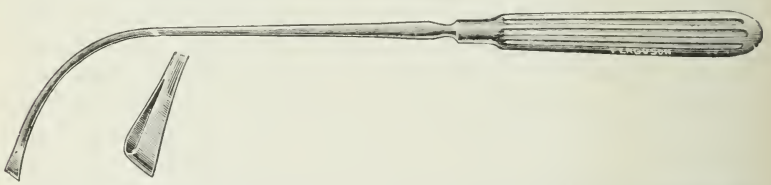


FIG. 146.—Harland's laryngeal curet. In order to reach all localities in the larynx the curet is provided with a flexible shaft that can be bent to enter any ordinary larynx, and has an edge that cuts upward and backward, and another that cuts downward and forward.

for any reason the morphin is objectionable, it may be omitted from the formula.

Excessive pain on swallowing may, of course, be relieved by cocainizing the larynx, either with an atomizer or a laryngeal applicater. A lozenge containing $\frac{1}{4}$ to $\frac{1}{2}$ gr. of cocain, dissolved in the mouth before meals, yields fairly satisfactory results. However, for the relief of painful deglutition no remedy yields such satisfactory results, everything considered, as orthoform.

This nearly insoluble substance has the property of producing analgesia when applied to exposed nerve-endings. It is, therefore, especially valuable as an application to irritable ulcers after they have been cleansed with Dobell's solution and peroxid of hydrogen. Its anesthetic effects are increased by a previous application of a solution of

cocain and persist for four or five hours. When insufflated into a tuberculous larynx the powder produces a momentary smarting, followed by analgesia more or less complete, which persists as long as the powder adheres to an abraded surface or an ulcer. The powder possesses decided antiseptic qualities and promotes the healing of tuberculous ulcerations. It has little effect upon the unbroken mucous membrane.

A nurse or one of the patient's friends can be taught to insufflate orthoform into a tuberculous larynx ten minutes before each meal, and in many instances thus secure complete relief from dysphagia. Orthoform is said to be nontoxic, and hence may be used locally in liberal quantities. It may, of course, be prescribed in the form of a lozenge, but with not nearly as satisfactory results as when the powder is insufflated into the larynx.

A spray of menthol in albolene (10 gr. to 1 ounce) may be used by the patient inhaling each time he compresses the bulb of the atomizer. It yields fairly satisfactory results in a few cases. However, before using any application to the larynx himself the patient should, of course, cleanse it as thoroughly as possible under the circumstances by inhaling the spray from an atomizer containing equal parts of Dobell's solution and peroxid of hydrogen.

Fluids, especially if iced, commonly cause much less pain on swallowing than solids, and iced milk can sometimes be taken through a tube with the patient's head hanging over the bed when it would be much more painful to sit up and drink the fluid; but in extreme cases the stomach-tube and rectal alimentation will have to be employed.

Syrupi lactic acid is a remedy that is said to have the property of destroying tuberculous structures without attacking the surrounding sound tissues. Its application to a tuberculous ulcer is so painful that its use should always be preceded by thoroughly cocainizing the larynx with a 10 per cent. solution of cocain. The applications can be made at intervals of four or five days and be preceded, if necessary, by cureting the cleansed ulcer. It is best to commence by lightly touching the parts with a 25

per cent. solution of the syrupy acid and gradually increasing the strength from visit to visit as the patient becomes accustomed to the pain. The remedy undoubtedly hastens cicatrization of ulcers and, it is claimed, promotes the absorption of deposits. It should be used with judgment and caution, as the edema is frequently increased for a day or two if lactic acid is applied too freely or an attempt is made to "rub in" the remedy upon the floor of a tuberculous ulceration.

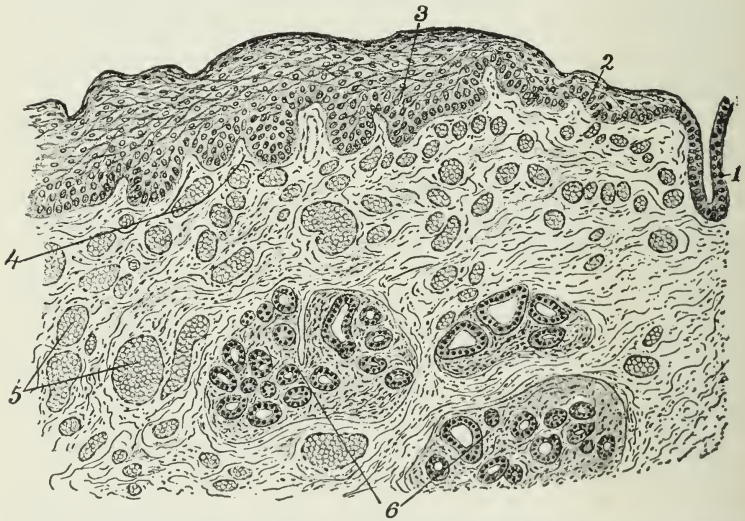


FIG. 147.—Pachydermia laryngis (× 60): 1, Cylindric epithelium; 2, area of transition into (3) stratified squamous epithelium; 4, papillary body; 5, dilated blood-vessels of tunica propria; 6, mucous glands. (Dürck.)

Laryngeal Tumors.—The tumors most commonly met with in the larynx are papilloma, fibroma, angioma, myxoma, cyst, sarcoma, and carcinoma.

Symptoms.—The most noticeable symptom is mechanical obstruction to breathing and phonation proportionate to its size and location. If the tumor is small and situated upon a vocal cord, dysphonia results from interference with its vibration, while, if the growth is situated in the anterior commissure between the cords, aphonia results from the tumor preventing their approximation. If, however, the

tumor is small and situated above the vocal bands, but slight, if any, subjective symptoms will be noticed. As the growth of a laryngeal tumor increases dyspnea increases and asphyxia may suddenly occur unless prompt relief is at hand. Cough is not usually present unless the growth is of such a character as to vibrate in the breath-current and titillate, as it were, the interior of the larynx (Fig. 148), when cough and laryngeal spasms may occur. Chronic laryngitis is usually present as the result of laryngeal tumors.

Papillomata found in the larynx of children offer some peculiarities. They are soft and usually multiple. They are usually associated with a catarrh of the nasopharynx and hypertrophied tonsils, and sometimes disappear under the application of astringent powders to the larynx and

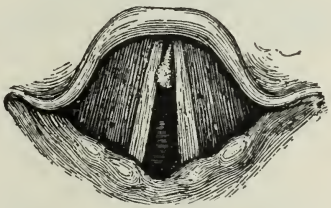


FIG. 148.—Pedunculated fibroma upon the under surface of the left vocal cord; position during inspiration (v. Zeimssen).

successful treatment of the nasal and pharyngeal affection, to the existence of which in many instances they seem largely due.

The papillomata of adults are harder than those of children, and are usually situated on the vocal cords or ventricular bands.

Etiology.—Any long-continued irritation of the laryngeal mucous membrane may result in hyperplasia and the growth of warts. When the result of long-continued catarrhal inflammation, papillomata usually occupy the interarytenoid space and the posterior extremities of the vocal cords.

Papillomatous growths are sometimes seen about tubercular ulcerations and upon the mucous membrane covering gummata and tumors lying underneath the laryngeal

mucous membrane. Under such circumstances a piece removed by the forceps from the larynx may under the microscope present the appearance of papilloma, and in its deeper parts that of carcinoma, and hence give rise to the erroneous impression that papillomata are prone to generate into carcinomata.

In case the papillomata occur in connection with laryngeal phthisis, syphilis, or a laryngeal tumor, they result from the irritation to the laryngeal mucous membrane caused by the primary disease.

Laryngeal carcinomata may be divided into intrinsic and extrinsic. Intrinsic carcinoma attacks the ventricular bands,

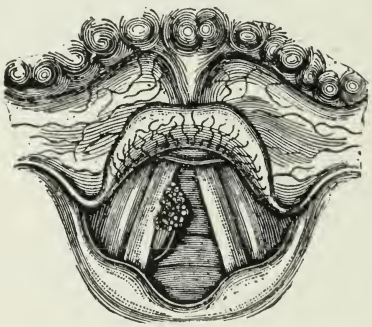


FIG. 149.—Papilloma of larynx (Stoerck).

the ventricle, and the vocal cords. Extrinsic has its origin upon the epiglottis, the arytenoid folds, and the pyriform sinus.

In extrinsic carcinoma the lymphatic glands are affected almost from the commencement, the disease rapidly advances toward a fatal termination, and is rarely, if ever, cured by operation.

Intrinsic carcinoma is a less grave affection; its advance is less rapid and the neighboring lymphatics often remain for a long time uninvolved. Extirpation, either partial or entire, should not be undertaken except the disease be intrinsic and limited entirely to the larynx.

Treatment.—Tumors springing from the epiglottis can usually be removed by means of a Jarvis snare with a

curved lip, while cysts may be opened with the laryngeal lancet (Fig. 141) and their contents allowed to escape, after which the end of a probe on which nitrate of silver has been fused should be passed into the cyst and its interior thoroughly cauterized. Papillomata (Fig. 149) and soft or pedunculated tumors should be removed by means of the laryngeal forceps (Figs. 151, 152), if necessary picking off piece after piece until the entire tumor has been removed. In every case of tumor of the larynx the emergencies of the case govern the operative procedures necessary. If the removal of the tumor is very urgent to prevent suffocation,

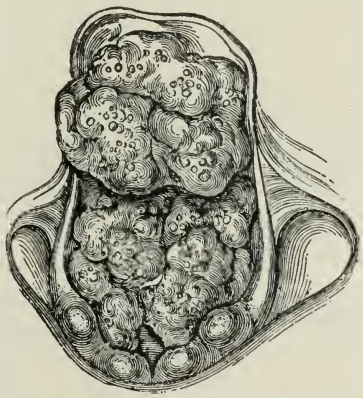


FIG. 150.—Carcinoma of the larynx (Stoerck).

and the patient's throat is too irritable to permit instrumental interference without danger of fatal result from induced spasm of the glottis, tracheotomy should, of course, be performed before the removal of the tumor is attempted. If the growth is malignant, extirpation of the larynx, either in part or as a whole, gives the only hope of bringing about a cure of the affection. The operation should be performed as soon as a certain diagnosis is established. In inoperable cases the *x*-ray may be used.

It is generally useless to attempt the removal of any laryngeal growth with the forceps until the larynx has been so thoroughly cocainized that no spasm occurs upon the

introduction of a probe. This can almost always be accomplished by painting the interior of the larynx with a 10 per cent. solution of cocain by means of a laryngeal applicator

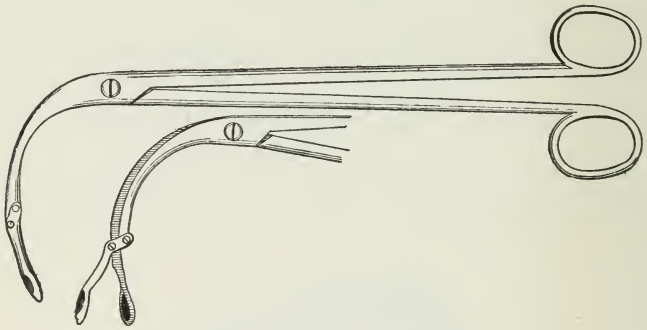


FIG. 151.—Cusco's laryngeal forceps.

until no spasm occurs when the applicator or probe is introduced into the larynx. In the larynx cocain anesthesia occurs more rapidly than in the nose, but lasts for only a short time.

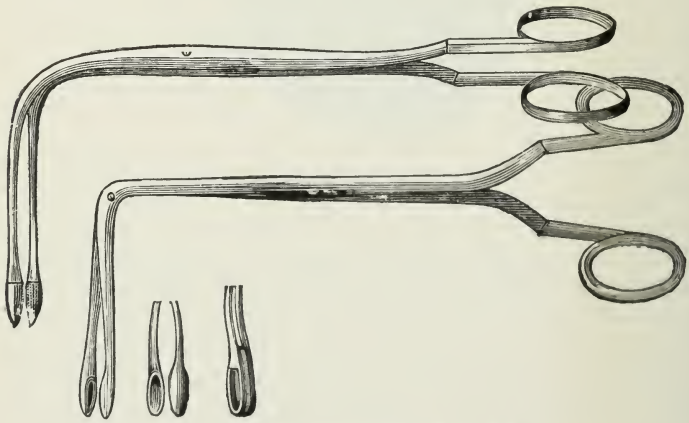


FIG. 152.—Mackenzie's laryngeal forceps.

Foreign Bodies in the Larynx.—Smooth substances, such as small pebbles, shoe-buttons, seeds of various kinds, etc., are not apt to lodge in the larynx, but are either removed

by a fit of coughing or drop into the trachea. Substances with sharp points, like fish-bones or pins (Fig. 153), are often partially imbeded in the tissues of the larynx.

Treatment.—The foreign body should be removed with the laryngeal forceps when possible. In rare cases a wound of the interior of the larynx is rapidly followed by edema of the glottis. Under these circumstances tracheotomy should be performed before any attempt is made to remove the offending substance.

Thyrotomy.—This operation consists in the separation of the two wings of the thyroid cartilage by means of an incision through the angle of the thyroid cartilage, thus exposing the interior of the larynx for the removal of tumors or foreign bodies that cannot be removed readily

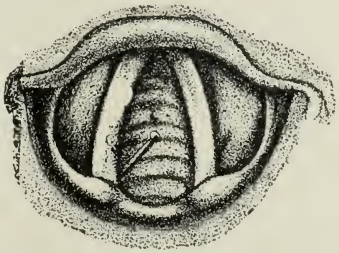


FIG. 153.—A pin imbedded in the posterior portion of the right vocal cord (Seiler).

through the mouth. The operation is done under chloroform anesthesia and in the tracheotomy position.

An incision is made through the skin from the thyrohyoid space to the upper tracheal rings exactly in the median line. The underlying structures are divided carefully by means of a knife and a grooved director. The thyroid prominence bulges out of the wound and can be opened by passing one blade of a stout pair of angular scissors through the cricothyroid membrane into the larynx. The larynx can also be opened by means of a stout bistoury or, when ossified, by means of a Sajous saw (Fig. 66). The edges of the wound are now separated with retractors in the hands of an assistant, and spasm of the laryngeal muscles, which always occurs when the larynx is opened,

is controlled by brushing the laryngeal mucous membrane with a 4 per cent. solution of cocain. The operation is a comparatively bloodless one and exposes in a very satisfactory manner the interior of the larynx for the removal of a foreign body or a tumor.

After the removal of the tumor or foreign body the severed edges of the cartilage are united by one or more catgut sutures and the skin wound brought together by sutures of worm-gut. Union usually occurs by first intention, but the ultimate condition of the voice depends upon the amount of damage done to the interior of the larynx. The removal of a foreign body or small tumor is not followed by any very appreciable impairment of the voice.

The after-treatment after removal of a small tumor by this method consists in keeping the patient quiet in bed for a week or so and forbiddiug the use of the voice. For the first few days the diet should be liquids.

NEUROSES OF THE LARYNX

Neuroses of the larynx are divided into sensory and motor neuroses.

Sensory neuroses are anesthesia, hyperesthesia, and paresthesia.

Anesthesia of the mucous membrane of the larynx, sometimes accompanying motor paralyses of the larynx, is occasionally observed in hysteria and in the insane.

Hyperesthesia acompanies all forms of laryngeal inflammation except some forms of early tuberculosis. It is frequently present in neurotics.

Paresthesia manifests itself chiefly as a sensation of choking or as of a foreign body in the larynx of hysteric individuals.

These sensations are sometimes the result of disease of the pharynx or tonsils, and when this condition exists it should receive appropriate treatment. In the mean time considerable relief will follow the administration of 10 to 15 gr. of the bromid of sodium three times a day.

Motor neuroses are spasm incoördination and paralysis of the laryngeal muscles.

Spasm of the laryngeal muscles appears in three forms—spasmodic cough, spasm of the adductors, and spasm of the tensors of the cords.

Spasmodic laryngeal cough or **laryngeal chorea** is a condition commonly described under this heading, although other respiratory muscles beside those of the larynx are involved in the paroxysms of coughing, which is of a peculiar bark-like character resembling that of a big dog. The paroxysms of coughing occur at frequent intervals during the day, but cease during sleep. The disease occurs more frequently in neurotic females than in males. It is not associated with chorea in any manner whatever, nor is there any evidence of laryngeal inflammation on examination with the laryngoscope.

Treatment should be directed toward improving the individual's general health. Good results generally follow the prolonged use of some nerve tonic like pil. sumbul comp., one after meals and at bedtime, but quicker relief can generally be obtained from bromid of sodium, 10 to 15 gr., after meals and at bedtime.

The use of the induced current, one sponge on the skin on each side of the larynx, does good probably from the impression it makes on the mind of the patient. To accomplish this the electricity should be used as strong as it well can be borne by the patient. Aside from the use of electricity local treatment is not indicated.

Spasm of the Tensors of the Vocal Cords.—This is a rare condition affecting singers, actors, and orators, somewhat analogous to the spasm of the muscles observed in the muscles of the hand in writers' cramp.

Symptoms.—The voice is suddenly lost, possibly in the midst of a sentence, by a spasm (sometimes painful) of the cords. The greater the effort to speak or sing, the tighter and longer the spasm. After a moment the spasm subsides and the voice is normal for several minutes, when another spasm may occur. Examination with the laryngoscope during a spasm shows the cords tightly approximated in the position for vocalization. There may or may not be slight hyperemia of the larynx.

Treatment consists in rest of the voice, preferably in the

country or at the seashore, tonics, and attention to personal hygiene.

Spasm of the adductor muscles or **laryngismus stridulus, false croup,** generally involves the crico-arytenoidei externi and the arytenoideus.

Etiology.—The condition usually occurs in neurotic children under three years of age. There is frequently some pathologic condition of the nose and nasopharynx that renders the nerve-endings of the upper respiratory tract more irritable, and in neurotic children is sufficient to induce a reflex spasm of the adductor muscles of the vocal cords from trifling causes, such as a slight lowering of the temperature during the night after the child has gone to bed, kicking off the bedclothing, etc.

In some adults the entrance of a small particle of food or dust into the larynx produces a condition similar to laryngismus stridulus. In such individuals applications to the nasopharynx of iodin-potassium-iodid-glycerin; solutions of sulphate of zinc or any of the other routine applications to the nasopharynx may be followed by alarming spasms of the laryngeal adductor muscles if a drop of the solution by any mischance happens to drip into the larynx. The same thing occurs in such individuals after the application of an ordinary remedy to the larynx.

To the inexperienced laryngologist the *symptoms* are sufficiently alarming. After the laryngeal application the patient suddenly becomes cyanosed and, with protruding eyeballs, clutches at his throat. The patient gasps. The respiration is loudly "crowing," like that of a child with laryngismus stridulus, and death from suffocation seems imminent. These alarming symptoms disappear as suddenly as they occurred if the patient makes an effort to pronounce words. The practitioner in a loud voice should command the patient to say "One, two, three," or in an equally loud and commanding voice inquire, "What is your name?" When the patient makes an effort to answer the spasm of the glottis vanishes and breathing becomes at once normal.

In the first stages of locomotor ataxia there is occasionally a history of spasms of the adductor muscles resembling laryngismus stridulus, and in an adult such a history in the

absence of foreign bodies gaining entrance into the larynx should be a sufficient warrant to search for other symptoms of this disease.

Symptoms.—In children the attack appears suddenly during the night in apparently healthy children. The child suddenly sits up in bed gasping for breath. At the height of the attack it is markedly cyanosed, when suddenly there is a deep inspiration and the symptoms rapidly disappear. There remains no symptoms of laryngeal inflammation except that during the day there may be a slight "croupy" cough.

Prognosis.—The attacks of false croup not infrequently recur at intervals for weeks or months. It is said that in very young children the attacks sometimes terminate in eclampsia or convulsions.

Treatment is directed to the prompt relief of the laryngeal spasm. This can sometimes be accomplished by making the child sneeze by tickling the nose with a feather or a pinch of snuff. When sneezing occurs the spasms cease. The inhalation of a few drops of chloroform from a handkerchief is generally effective. Extreme heat or cold to the skin over the larynx or 3 drops of adrenalin chlorid solution (1 : 1000) hypodermically will sometimes relieve the spasm. Any or all of these measures should be tried while a hot mustard-bath is being prepared. The child should be placed in this and, after remaining for a few moments, taken out and carefully wrapped in a warm woolen blanket before being replaced in bed. For very severe attacks Coakley advised the following as a rectal injection:

℞ Chloralis hydratis, gr. vj;
Potassæ bromidi, gr. x;
Aquæ, q. s. ad. f℥j.—M.
Sig. Use as a rectal injection for a child six months old.

As a prophylactic between the attacks all sources of irritation should be sought for and removed. These may include errors of digestion, carious teeth, or nasopharyngeal disease. Hearty suppers and lunches at bedtime should be forbidden.

Somnos in ½-teaspoonful doses should be given every

three hours during the day for a week or more or until the immediate danger of a recurrence of the attack seems to have disappeared. The child should then take syrup of the iodid of iron after meals, 1 drop for each year of its age, up to 10 drops, with or without cod-liver oil. Syrup of the hypophosphites may be substituted for the iron at the physician's discretion.

In adults and nervous children sodium bromid answers a useful purpose. Pil. sumbul comp. or some other combination of iron, valerian, and asafetida may be given.

Laryngeal Vertigo or Epilepsy.—This is a rare laryngeal neurosis occurring more frequently in males than females.

Etiology.—The disease occurs in neurotic individuals, and the symptoms are probably due to an incoördination of the respiratory centers implicating the laryngeal muscles in such a manner as to produce closure of the glottis.

Symptoms.—The prodromes are a tickling sensation in the larynx and a fit of coughing. The patient draws a long breath. The glottis closes and the inspired air is confined in the lungs. There follows vertigo, cyanosis, and sometimes loss of consciousness. The "fit" then passes off, to be repeated at intervals.

The laryngoscope shows no characteristic lesion; a normal larynx or slight catarrhal inflammation being commonly observed. Disease of the nose and pharynx catarrhal in character is frequently present in such cases.

Prognosis.—The prognosis as regards life is favorable. There may, however, be a recurrence of the attacks of laryngeal vertigo extending over a period of years.

Treatment.—The treatment, like that of other neuroses, consists in hygienic measures calculated to improve the individual's general health, and if the attacks are frequent the administration of antispasmodics. Galvanic electricity, the positive pole over the larynx, may be employed.

Paralysis may affect but one laryngeal muscle or pair of muscles; or it may affect several of them at once, and may be either unilateral or bilateral. Paralysis of the larynx may be divided clinically into paralysis of the adductors, paralysis of the abductors, and paralysis of the tensors of the cords.

Etiology.—The laryngeal muscles receive their nerve-sup-

ply by means of two branches of the pneumogastric—the superior laryngeal and the recurrent laryngeal. The pneumogastric, at its origin, is a sensory nerve, but receives motor fibers from the spinal accessory, so that it possesses both sensory and motor functions above the point where the superior laryngeal is given off. Paralysis of the laryngeal muscles may be due, like paralysis of other muscles, to (1) disease or injury of the brain involving the cerebral portion of the nerves that supply the larynx; (2) injury or pressure of the nerves below their cerebral portion; (3) an abnormal condition of the muscles themselves, and (4) some systemic dyscrasiæ, like rheumatism or hysteria, because of which the muscles are unable to respond to nervous influence.

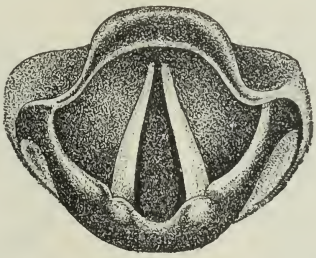


FIG. 154.—Bilateral paralysis of the adductors (crico-arytenoid lateralis and arytenoideus). Appearance in attempted phonation (Lennox Browne).

Adductor Paralysis.—Adduction of the vocal cords being performed by means of the lateral crico-arytenoid muscles and the arytenoideus muscle, paralysis of these muscles causes the cords to remain in a state of extreme abduction. This condition is in most instances due to hysteria, rheumatism involving either the muscles or the cricothyroid joint, or chronic poisoning by lead or arsenic. If bilateral paralysis exists, the vocal cords will be seen in the laryngeal mirror separated to the utmost degree (Fig. 154), and the voice will be completely lost. If paralysis of the arytenoideus muscle alone exists, which, however, is rarely the case, the anterior two-thirds of the vocal bands can be approximated; but a triangular space will be left behind the vocal processes during phonation, through which the breath escapes and renders the voice feeble, and its use in singing and speaking

both fatiguing and unsatisfactory. This condition of affairs may occur during the course of either acute or chronic laryngitis from extension of the inflammation to the arytenoideus muscle (Fig. 155).

In unilateral adductor paralysis only one cord is seen in extreme abduction during phonation, and the opposite cord will be observed to pass beyond the median line, so as to approach as near as possible to its motionless companion (Fig. 156). Although aphonia exists, the whispered words are usually perfectly comprehensible.

Abductor Paralysis.—Abduction of the vocal cords is accomplished solely by means of the crico-arytenoid muscle,

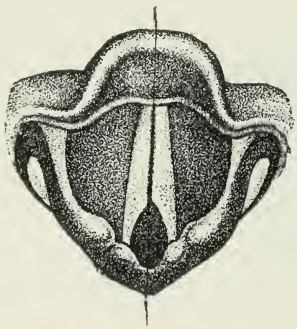


FIG. 155.—Bilateral paralysis of the arytenoideus (Lennox Browne).

FIG. 156.—Unilateral paralysis of adductor of left cord. Appearance in attempted phonation (Lennox Browne).

and hence the complete paralysis of both of them will prevent separation of the cords, and almost completely prevent the entrance of air into the lungs; a mere slit posteriorly, which represents the action of the arytenoideus, being the extent of the available breathing space. During expiration, however, the vocal cords are forced apart by the ascending air-current impinging upon their under surfaces, which curve upward from the sides of the larynx. The voice is unimpaired in this affection, but where complete paralysis of the abductors exists it may be necessary to perform tracheotomy to prevent suffocation occurring as the result of slight inflammatory swelling of the mucous membrane of the larynx as

the result of a cold. Paralysis of the abductors may result from a tumor in the brain involving the origin of both pneumogastrics and spinal accessory nerves. In such cases the abductors of the larynx are first paralyzed, but as the tumor increases in size paralysis of the muscles of the larynx results, the cords assuming the "cadaveric position" (Fig. 157). Paralysis of both posterior crico-arytenoid muscles may result also by pressure upon the recurrent laryngeal nerves by an aneurism, a goiter, or carcinoma of the esophagus, or the lesion may be located in the muscles themselves. When unilateral paralysis only is present, the affected cord will be seen to remain always in the median line, even during forced inspiration, but subjective symptoms will be so slight as to hardly attract attention. The voice will be perfect and the breathing space ample, except during violent exercise (Figs. 158, 159).

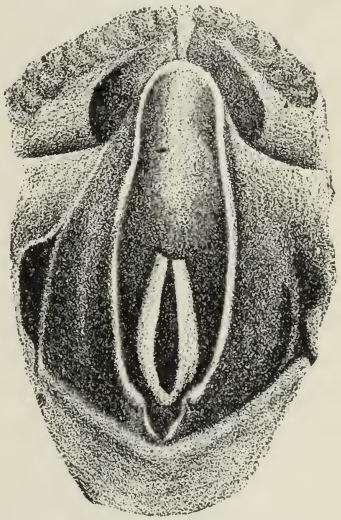


FIG. 157.—Appearance of the normal larynx after death, showing the "cadaveric position" of the vocal cords. This is also their position in quiet breathing (Lennox Browne).

Two forms of *paralysis of the tensors of the vocal cords* are met with, one due to paralysis of the cricothyroid muscle, which is rare, and the other one to paralysis of the thyro-arytenoids, which is not uncommon. Paralysis of the former muscle causes the edges of the cords to assume a wavy line, touching each other at irregular intervals during phonation (Fig. 160), while the voice is coarse and remains always at the same pitch. The upper surface of the cords appears convex during expiration and concave during inspiration. When the thyro-arytenoids are paralyzed, the cords assume a slightly curved appearance when an attempt is made to bring them together during phonation, and a slight space remains between their centers (Fig. 161). The

voice is husky, high pitched, and weak, the air escaping through the elliptic space between the cords, necessitating great effort on the part of the patient in order to speak.

Treatment.—The cause of the paralysis should be carefully sought and treated, the success of the measures adopted depending, of course, upon the nature of the primary ailment. In suitable cases strychnin should be administered in gradually increasing doses until the limit of toleration has been reached, and galvanism or faradism used by means of the laryngeal electrode (Fig. 162), applied within the larynx as near as possible to the affected muscles. An ordinary sponge electrode is held by the patient or an

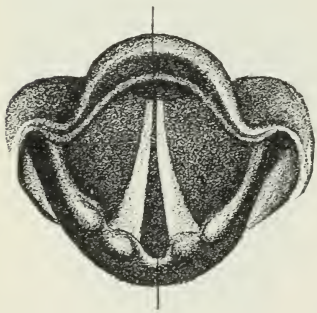


FIG. 158.—Bilateral paralysis of the abductors (crico-arytenoidei postici). Appearance with deep inspiratory effort (Lennox Browne).

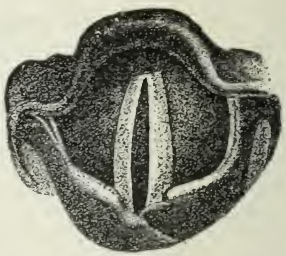


FIG. 159.—Unilateral paralysis of the left abductor. Appearance in phonation. The affected cord is seen to be in the cadaveric position, while the other is advanced beyond the median line (Lennox Browne).

assistant upon the skin over the larynx, while the operator guides the tip of the electrode into the larynx, watching its progress with the laryngoscope, until it is in the desired position. The finger-rest on the top of the handle of the instrument is now depressed and the current passes. Each application should last but a few seconds, and be repeated three or four times at each sitting, at intervals of one or two minutes. Electricity may be used in this manner every other day, the current used not stronger than is sufficient to secure contraction of the affected muscles. At first the mere introduction of the electrode into the larynx causes retching and gagging, and it may be necessary to apply a

10 per cent. solution of cocain to the interior of the larynx by means of a pledget of cotton wrapped about the end of a probe and dipped into the solution in order to anesthetize the parts sufficiently to admit of free manipulation at the first sitting. After a few trials, however, the parts become

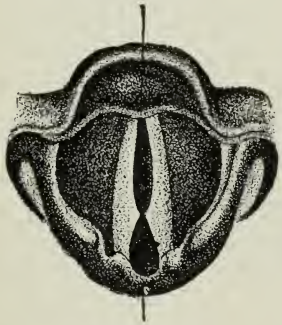


FIG. 160.—Bilateral paralysis of the thyro-arytenoidei and of the arytenoideus (Lennox Browne).

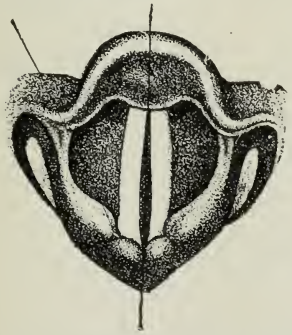


FIG. 161.—Bilateral paralysis of the sphincter of the glottis (thyro-arytenoidei) (Lennox Browne).

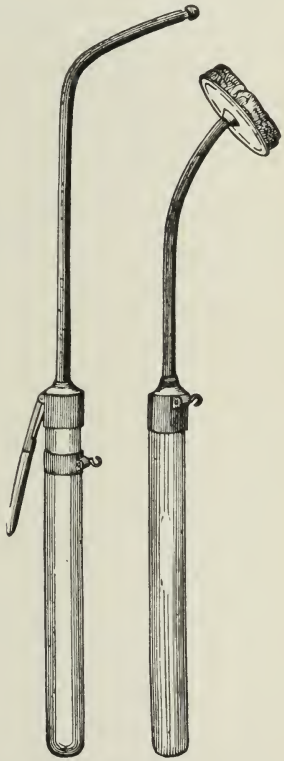


FIG. 162.—Mackenzie's laryngeal electrode.

more tolerant and applications can be borne, in the majority of instances, without trouble.

Diphtheria is an acute infectious disease characterized by a pseudomembrane which usually appears in the fauces, and is associated with a rapid pulse, moderate elevation of temperature, and depression.

Etiology.—Diphtheria is endemic in all large cities, especially in the more crowded localities, and from time to time becomes epidemic, spreading to the outlying districts. It is more prevalent in the spring, autumn, and winter than in the summer. The specific cause is the Klebs-Löffler bacillus.

Pathology.—The location and extent of the pseudomembrane varies in each case. It may be limited to the tonsils or it may cover the entire fauces and extend into the nares and the larynx. It sometimes extends through the Eustachian tubes to the middle ear. When a diphtheritic membrane is forcibly removed it invariably leaves a bleeding surface.

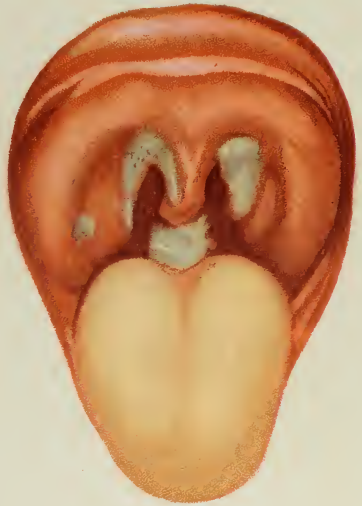
The bacilli are deposited in the fauces first and cause the membrane to become red, inflamed, and swollen. The poison kills the superficial layer of epithelial cells, which undergo coagulation necrosis. There is a migration of white blood-cells, which also undergo coagulation necrosis. These processes may only extend through the superficial layer of the mucous membrane, but sometimes extend deep into the tissues and produce gangrenous ulcers. The color of the pseudomembrane is gray or grayish white at first. It sometimes becomes yellow, but more often is white and flaky, like leaf-lard; it may also assume a dirty brown color, due to hemorrhage or to the local use of iron solutions.

Post mortem, the heart and blood-vessels show degenerative changes. The heart may contain a blood-clot. The lungs frequently show evidence of fibrinous pleurisy, bronchopneumonia, or capillary bronchitis. The liver and spleen show little if any change. The kidneys frequently show cloudy swelling. Degenerative processes have also been found in the nerve-trunks.

Classification.—Diphtheria may be classified as *mild*, *well marked*, *severe*, and *malignant*.

When classified according to location, as *faucial*, *nasal*, and *laryngeal*. There nearly always is, or has been, some evidence of the disease in the fauces when either nasal or laryngeal diphtheria exists.

Symptoms.—In some cases of diphtheria there are very few or no symptoms at all, except a slight indisposition on the part of the child, and the true nature of the disease may



Diphtheria of the pharynx and tonsils (Northrup).

Follicular tonsillitis (Northrup).

never be recognized unless by accident. The ordinary attacks of diphtheria, however, usually begin with chilly sensations up and down the spine; occasionally with a distinct chill and rarely with a convulsion. This is followed by a rise in temperature, quickened pulse, headache, pains in the limbs, coated tongue, and sometimes nausea and vomiting. Frequently there is stiffness of the muscles of the neck. Sore throat and painful deglutition may or may not be present.

The temperature rises to 101° or 103° F. by the end of the first day. The pulse is rapid and ranges between 110 and 130. The throat looks red and inflamed at first, then there is a deposit of exudate on the tonsils, as a rule, and it spreads to the adjacent mucous membrane or may limit itself to the tonsils. It is first of a gray or grayish-white color, which becomes white or a dirty yellow as it grows older. The glands at the angle of the jaw become swollen and sensitive. Constipation is frequently present. The urine is scanty and high colored. It may show albumin and even casts. In the ordinary cases the depression is never profound and may be absent altogether.

In favorable cases the disease reaches its height by the fifth or sixth day, but the temperature usually falls to normal on the third or fourth day. The exudate usually disappears by the tenth day and convalescence is well established. Paralysis follows but seldom in cases where the exudate is limited to the tonsils.

In severer types of the disease the initial symptoms are more pronounced. The depression is marked and comes on early. The fauces are greatly inflamed and the tonsils so swollen as to meet in the center of the pharynx. They are covered by a thick exudate, which impedes respiration and articulation. The uvula is swollen and usually covered by exudate, which extends forward to the hard palate, and may be nearly $\frac{1}{2}$ inch thick at the junction of the soft and hard palate. The posterior nares are involved by extension of membrane up the posterior surface of the uvula. This often rapidly extends to the anterior nares and both nostrils may become completely plugged by the exudate. There is a serous acrid discharge from the anterior nares, which

excoriates the skin of the upper lip. The cervical glands are markedly enlarged and the cellular tissues swollen and edematous. The edema at times extends down upon the sternum for several inches.

The temperature is usually normal or subnormal after the second or third day. The pulse is rapid, but soon becomes irregular and intermittent. Depression is marked from the beginning. The urine is scanty and high colored. Most severe cases show albumin and casts. Vomiting is frequent. Epistaxis and hemorrhage from the fauces and buccal membrane are common. The breath is offensive. The patient rapidly grows pale and anemic. The skin on the face has a drawn and glossy appearance. The child may die in a few days, overwhelmed by the diphtheritic poison, or linger for several weeks and die of toxemia or paralysis. Any case of diphtheria, however severe, may recover or death may occur suddenly from paralysis of the heart. When recovery takes place convalescence is usually protracted and very tedious. Paralysis, either local or general, often supervenes.

Nasal diphtheria usually occurs in conjunction with the faucial variety or it may follow it. Occasionally it occurs as a primary disease; then the symptoms are milder and the exudate is not so extensive. There is always a marked tendency to systemic infection whenever the nares are secondarily involved. Convalescence is slow and tedious in cases that recover.

Variations from the above descriptions are numerous, for no other disease presents so many phases as diphtheria.

In *laryngeal diphtheria* there are hoarseness and a high-pitched, metallic cough—the so-called croupy cough—which comes on in paroxysms. There is a slight rise in temperature and the frequency of respiration is slightly increased. As the exudate extends the hoarseness and aphonia increase. Finally, the respiration becomes embarrassed and stridulous. The auxiliary muscles of respiration are brought into action. There is marked retraction in the supraclavicular and suprasternal spaces; also at the substernal space and at the border of the ribs. The alæ of the nose dilate with each respiration. The inspiration is long, deep, and labored, and more difficult than expiration, which may be comparatively

easy. The child is restless, clutching at the sides of the bed or anything to raise itself up. The face is pale and bathed in a profuse perspiration. The patient has a wild, hunted expression. As the obstruction increases cyanosis appears, the extremities become purple, the lips and face of a livid hue. Sometimes during a fit of coughing membrane is expelled as a complete cast of the larynx, trachea, and sometimes even of the smaller bronchi. This, as a rule, only gives temporary relief, for the membrane quickly reforms and all the symptoms return. Unless these cases are relieved by intubation or tracheotomy cyanosis becomes greater until the child dies asphyxiated.

Diphtheritic paralysis is a neuritis rather than a true paralysis, due to the absorption of the toxalbumins of the disease, and generally is proportionate to the severity and extent of the acute condition. Rarely marked paralysis follows mild attacks—10 to 20 per cent. of diphtheria cases are followed by paralysis—which may be either local or general. The local variety is usually noticed by the end of the first or during the second week. The most frequent paralysis is that of the palatal muscles, giving a nasal sound to the voice. Fluids are regurgitated during swallowing. Strabismus and ptosis are sometimes seen. Paralysis of accommodation is not infrequent and paralysis of the tensor tympani and stapedius occasionally occur. Facial paralysis is occasionally seen. Loss of power in the lower extremities with inability to walk is quite common.

General paralysis usually makes its appearance from the fourth to the sixth week, and all the muscles of the body may be affected except the sphincters, which are usually spared. When all the muscles of the body are affected the temperature is usually subnormal, the pulse rapid and intermittent or very slow. When paralysis is extreme the child lays perfectly quiet, unable to move, and frequently unable to swallow. There is usually associated with these conditions a low dragging cough, quite characteristic.

Systemic Infection or Toxemia.—Some of the mild cases have very little constitutional disturbance. On the other hand, some patients are overwhelmed by the poison in a few days. More often toxemia comes on later when acute

symptoms have subsided and the exudate disappeared. The patient appears bright and is apparently convalescing, except that his color is noticed to be growing paler. The pallor increases daily until the pink hue disappears from the lips, lobes of the ears, the palms of the hands, and soles of the feet. Exhaustion is extreme. The temperature is usually subnormal. The pulse may be slow or very rapid. The extremities are cold. The stomach is irritable. The least food, even cracked ice, will excite vomiting. The mind remains bright and clear. Such cases usually die of toxemia and exhaustion, and follow when the local disease has been extensive and the depression well marked.

Complications.—Epistaxis is frequent when the nares are involved and, in severe cases, hemorrhage from the fauces and buccal mucous membrane. Capillary bronchitis or bronchopneumonia is quite common and frequently fatal. It occurs during the height of the disease or during convalescence. A fibrinous pleurisy is frequently seen post mortem and occurs in conjunction with bronchopneumonia. Albuminuria is present in nearly all severe cases and occasionally gives rise to alarming symptoms. Suppression of urine may follow. Otorrhea is not uncommon, and bacilli are found in the discharges for many weeks or even months after convalescence is fully established. Pericarditis and endocarditis may also occur, but are rare.

Diagnosis.—The characteristic pseudomembrane, which leaves a bleeding surface when removed, its gray or grayish-white color, its tendency to spread to the adjacent mucous membrane, the swelling of the cervical glands, and the presence of the bacilli renders the diagnosis in typic cases quite easy.

Mild cases may be confounded with follicular tonsillitis. The anginose variety of scarlatina may present some difficulty, but the strawberry-tongue, continued high fever, absence of the Klebs-Löffler bacilli, and the presence of the characteristic scarlatinal rash will exclude diphtheria.

Bronchopneumonia may be mistaken for the laryngeal variety. In pneumonia the respirations are panting and rapid; in laryngeal diphtheria they are long, deep, and labored, and the stridor usually well marked. The his-

tory of a faucial or nasal diphtheria will often clear the diagnosis.

Prognosis depends upon the character of the epidemic, the type of the disease, and the age of the patient. The death-rate depends upon the number of laryngeal cases requiring operative interference. From this class alone the death-rate varies from 30 to 75 per cent. The age of the patient also influences the prognosis. Under one year of age, from 50 to 90 per cent. die; from one to five years of age, about 40 per cent.; from five to ten years, 26 per cent.; from ten to fifteen years, 12 per cent.; over fifteen years, 3 to 4 per cent.

Treatment is divided into (1) prophylactic; (2) local; (3) constitutional; (4) serum; and (5) operative.

Prophylactic treatment consists in adopting those measures that will prevent the spread of the disease. This is best obtained by placing the patient in a well-ventilated room, preferably on the top floor, and having it isolated. All bed-linen, towels, garments, and eating utensils used by the patient should be disinfected with a carbolic acid solution (5 per cent.) before leaving the room. The attendant's clothing should be changed before mingling with other people. The physician should wear a linen duster or gown when visiting the patient. After the patient has recovered the room and its contents should be disinfected thoroughly with formaldehyd gas.

Local treatment is to reduce the inflammation, prevent the spread of the exudate, and remove what has already formed.

For this purpose peroxid of hydrogen, either in full strength or diluted to suit the case, is the best local application. It should be used in the form of a spray or upon a cotton swab.

Many favor astringent solutions, preferably of the iron salts; as,

℞ Acidi carbolici, ♏xv;
Ferri perchloridi, f℥ij;
Glycerin,
Aqua, āā f℥j.—M.
Sig. To be used every hour or two by means of a swab.

The solvents—lactic acid, pepsin, caroid, trypsin—have many advocates. Lennox Browne is very partial to lactic acid applied pure twice daily, and diluted to three or four times its bulk with water, applied by the attendant every two or three hours. Löffler's toluol solution gives good results in some cases, but care must be used in applying it. Applications of a solution of nitrate of silver (60 gr. to 1 ounce of water) carefully to the tonsils, palate, and lateral walls of the pharynx twice or thrice a day when they are alone affected seems to check the extension of the membrane, but whatever remedy is selected, the practitioner should see that it does not increase the inflammation or else it will do more harm than good.

Constitutional Treatment.—Iron and mercury are the two drugs we have to rely upon in the treatment of this disease. They may be used alone or combined as follows:

℞ Tr. ferri chloridi, ℥ij;
Syr. limonis,
Glycerin, *āā* ℥iij;
Aqua, q. s. ad. f℥iij.—M.
Sig. 1 teaspoonful every hour or two for a child four years old.

℞ Hydrarg. chlor. corros., gr. i–ss;
Tr. ferri chlor., f℥ij;
Syr. limonis,
Glycerin, *āā* f℥iij;
Aqua, q. s. ad. f℥iij.—M.
Sig. 1 teaspoonful every hour or two for a child four years old.

Instead of the bichlorid, calomel may be given ($\frac{1}{10}$-gr. doses every two hours).

Stimulants are indicated from the beginning; alcohol is undoubtedly the best and should be pushed to its physiologic limit in severe cases. After the exudate disappears the whisky should be gradually withdrawn and digitalis substituted. When the stomach is irritable, digitalin should be given. A child five years old can be given $\frac{1}{30}$ to $\frac{1}{15}$ gr. or more if necessary.

Strychnin is also useful, especially in the later stages. It can be given in larger doses than is ordinarily employed.

The Serum Therapy.—To obtain the best results antitoxin

should be used early in the disease, and should be used in all cases of suspected diphtheria.

In mild cases 1000 units, repeated the next day, will be all that is necessary.

In severe cases it is well to begin with 2000 units as the initial dose and repeat every six, twelve, or twenty-four hours, until the symptoms begin to subside. When the disease persists it is sometimes necessary to give as high as 20,000 units in divided doses. Antitoxin of the highest potency should always be selected, for this gives the maximum number of units and the minimum amount of serum. It should be injected under antiseptic precautions to prevent abscesses, which occur in spite of antiseptic precautions in about 1 case in 500.

Operative intervention is indicated: (1) When the patient is cyanosed, together with marked retraction of the supraclavicular, substernal, and subcostal spaces, great restlessness, cold and clammy sweats. (2) When the symptoms of obstruction in the larynx are not so marked, but are rapidly growing worse, intubation preserves the strength of the patient. (3) When the symptoms of obstruction are not progressing, but are sufficient to prevent the patient obtaining rest. (4) In severe cases of nasal and faucial diphtheria which develop laryngeal symptoms, intubation permits the patient to die easy.

Intubation.—Select a tube suitable for the age of the patient, pass a strong silk thread through the eye of the tube (about 20 inches long) and tie the two ends together. Then screw the obturator on the introducer and place the tube on the obturator. Next, wrap the patient tightly in a sheet with his hands at the side to prevent them from interfering with the operator. Have the nurse sit in a chair and hold the patient upon her lap with his back to her left chest and his legs between her knees. The operator should sit in a chair facing the patient and place the gag in the left corner of the mouth. An assistant standing behind the nurse holds the gag and steadies the patient's head between his hands. Then the operator, taking the introducer in his right hand and holding the thread attached to the tube on one finger, rapidly introduces the index-finger

of the left hand over the tongue until it is behind the epiglottis and the laryngeal orifice is felt. Then the tube is introduced over the tongue, being careful to keep it in the median line, until the tip of the finger at the opening of the larynx is felt (Fig. 164). Next, elevate the handle of the introducer until the tube is in a vertical position and it readily slips into the larynx. When the tube is in the larynx press forward the button on the top of the introducer,

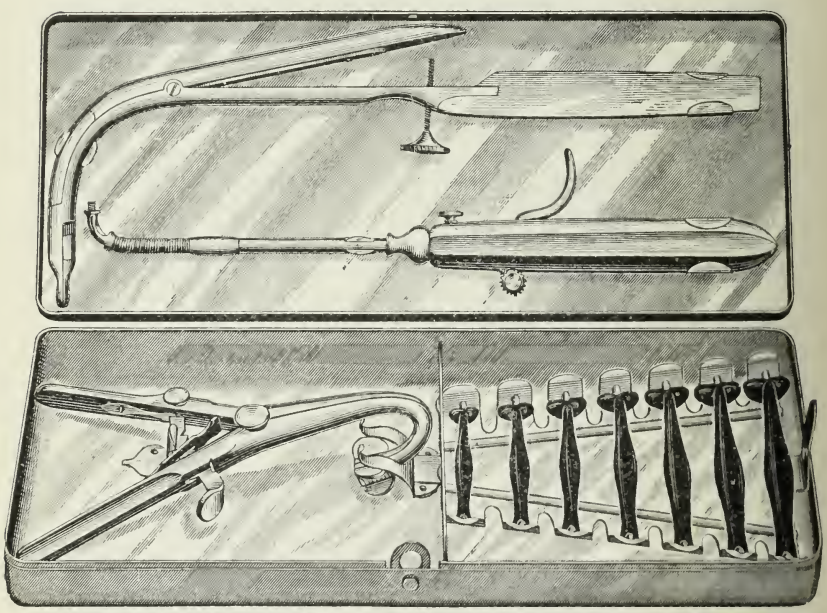


Fig. 163.—O'Dwyer's intubation set.

which releases the obturator. The finger should be placed on the head of the tube until the obturator is entirely withdrawn. Next, remove the gag, but hold the end of the string until you are satisfied the tube is in the larynx and the child has obtained relief. This usually requires three or four minutes. After respirations become easy, the string should be removed or plastered on the side of the face. To remove the string the gag should be placed in the mouth

and the finger should be held on the top of the tube until the thread is removed, to prevent removing the tube also.

Accident Following Intubation.—Occasionally the membrane of the larynx becomes detached and is pushed down before the tube, completely obstructing respiration. It does not often happen, but when it does the tube should be removed at once by pulling on the thread attached to the tube.

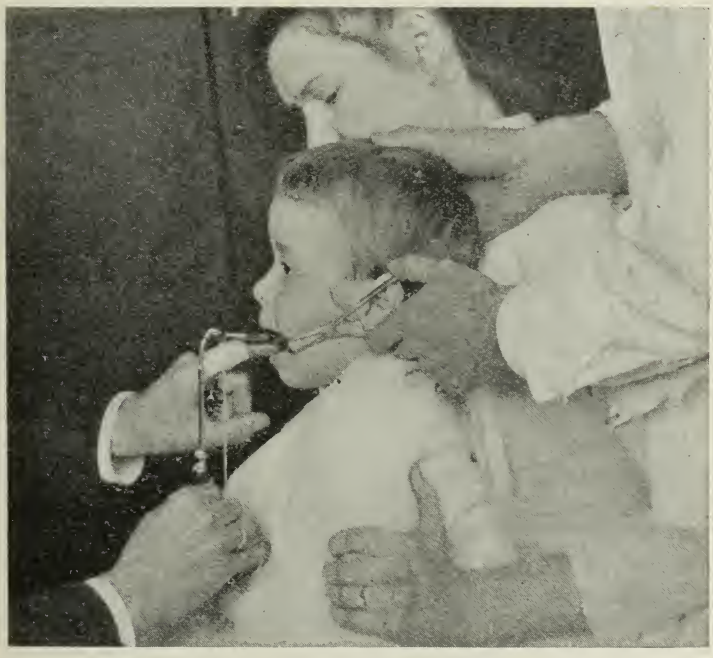


FIG. 164.—Intubation: inserting the tube (*American Text-book of Diseases of Children*).

This is followed by a forced expiratory effort, which, as a rule, expels the membrane. When it does not, tracheotomy should be performed immediately.

After intubation deglutition is difficult, the patient being able to swallow only liquids and semisolids. The temperature may remain normal, but, as a rule, it rises to 102° to 103° F., and remains from 1 to 2 degrees above normal while the tube is in the larynx. When intubation gives

perfect relief, the respirations are free and easy and the child is entirely comfortable. The coughing attendant upon deglutition is sufficient to keep the tube patulous; but should it become occluded or the respirations labored, the tube should be removed and cleansed. The reintroduction should depend on the character of the respirations after removal of the tube. In some cases the patient coughs up the tube when it becomes occluded, but when the tube is being constantly coughed up it indicates that it is too small and a larger size should be used. In favorable cases the time for removal of the tube will depend to a great extent upon the age of the patient. In children six or seven years old the tube may be removed in four or five days; in younger children it should remain five to seven days. When death results after intubation it is almost always due either to the extension downward of the membrane or to bronchopneumonia.

An amazing and distressing complication that sometimes arises is the inability of the patient to breathe without the tube. Children sometimes are obliged to wear the tube one hundred and ten days, being entirely well, except that they could not breathe without it. The prolonged wearing of the tube sometimes produces ulcers in the larynx, which may result in complete occlusion of that organ or so constrict the lumen that a tracheotomy is necessary.

Extubation.—The patient is prepared in the same manner as for intubation. The gag is introduced and an assistant steadies the head of the patient. The operator introduces the left index-finger in the mouth until the tube is felt behind the epiglottis. Then with the extractor in his right hand the beak is glided over the tongue until the tip of the finger is felt at the opening of the tube, when the handle is elevated and the beak of the extractor slips into the tube. Then, pressing the lever on top of the handle, the blades of the beak separate and hold the tube securely until it is withdrawn.

Treatment for Intubation Patient.—When the nares are involved they should be syringed several times daily with the normal salt solution, otherwise local treatment is unnecessary and may be harmful. Steam generated in the pres-

ence of the patient is no longer considered necessary. Constitutionally, stimulants should be given as required, preference being given to alcohol and strychnin. Calomel in small doses often seems to do good in limiting the inflammation and preventing bronchopneumonia. Iron mixtures are difficult to swallow and are just as well omitted. A simple cough mixture containing ammonia carbonas and syrup of ipecac often aids in liquefying and expelling the mucus from the throat. The most important element in the treatment is the nourishment. Milk should be given freely. Broths of all kinds, beef-tea, milk-toast, and ice-cream may be given freely.

The method of *administration of food* and medicines is a much-mooted question. Nursing infants take nourishment readily from the nursing-bottle. In such cases lowering the head makes swallowing easier, as none of the food gets into the tube. In older patients it is best to permit them to take their food from a glass or in any way they prefer. Struggling to make the patient take it in a specified way produces exhaustion and is harmful. When children will not take food, they should be fed by introducing a soft-rubber catheter through the nose into the stomach.

Tracheotomy is indicated in the same cases as intubation and for the same reasons. In addition, it is indicated in those cases of intubation where the membrane has extended below the tube. It is also performed in cases of foreign bodies in the larynx or lower air-passages, malignant or benign growths in the larynx, edema of the larynx, fracture, gumma, tuberculosis, and spasm of the larynx.

High and Low Operations.—The high operation is an opening into the trachea through the cricothyroid membrane, including, in some instances, the cricoid cartilage and the first ring of the trachea. The incision into the trachea is *above* the thyroid isthmus. The low operation is an incision of the trachea *below* the thyroid isthmus. In this situation the opening into the trachea can be made longer, and for this and other reasons is usually the preferable operation.

Tracheotomy has been characterized as one of the most easy or one of the most difficult of surgical operations.

The difficulties of the operation are enormously increased by the presence of a fat short neck and venous congestion.

Anesthetic.—In diphtheria and where there is stenosis of the larynx from any cause or great inflammation or irritability of the larynx and trachea, chloroform is the preferable anesthetic. In cases where the supply of oxygen has been deficient for some time it seldom requires more than a few whiffs of chloroform to produce unconsciousness. The chloroform, therefore, should be used with great care.

Cocain may be employed locally in adults by injecting one-quarter of a 1 per cent. solution subcutaneously along

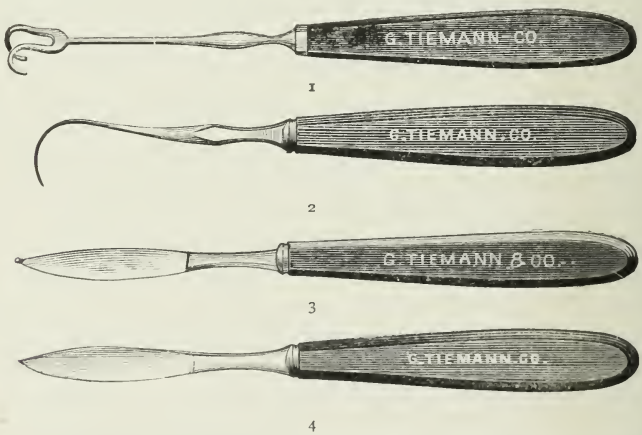


FIG. 165.—Tracheotomy instruments: 1, Blunt retractor; 2, sharp tenaculum, preferably grooved on convex side; 3, 4, sharp and probe-pointed scalpels.

the line of incision. From 2 drams to ½ ounce of the solution should be necessary to produce local anesthesia.

Instruments Required.—The instruments required are a small scalpel, a bistoury, stout angular scissors, dissecting forceps, one-half dozen artery clamps, two grooved directors, catgut ligatures, tenaculum, two blunt retrators (Fig. 165, 1), Delaborde's tracheal dilator (Fig. 166), and tracheotomy-tubes (Fig. 168).

Preparation of the Patient.—The patient is placed on the table with a small hard pillow, preferably one filled with sand,

under his shoulders in such a manner as to bring the trachea prominently into view (Fig. 167). However, it is best not to adjust the sand-pillow until after the anesthetic has been

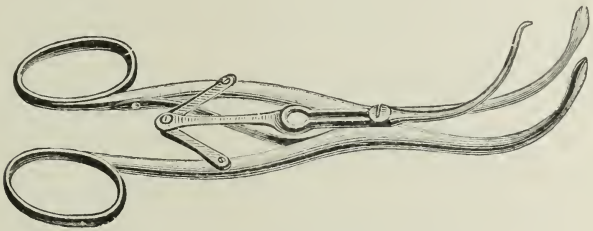


FIG. 166.—Delaborde's tracheal dilator.

given. The skin of the neck is scrubbed with green soap and washed with benzene and then with alcohol. Wet bichlorid towels are then placed over the chest and scalp and under the neck and shoulders.

FIG. 167.—Position of patient for tracheotomy (*American Text-book of Diseases of Children*).

The High Operation or Laryngotracheotomy.—For the high operation an incision is made in the median line from the top of the thyroid cartilage to the second tracheal ring.

The handle of the scalpel is used to uncover the cricothyroid membrane (Fig. 132), on which will be seen, extending transversely across, the cricothyroid artery and vein. Pushing these to one side a transverse incision is made through the membrane and mucous membrane of the larynx. A tracheotomy-tube is then inserted.

This is the simplest and easiest form of the "high operation" and is properly called *laryngotomy*. It is useful in cases of imminent suffocation, when there is not time to perform a deliberate low tracheotomy.

In cases where sufficient room is not secured by a transverse incision of the cricothyroid membrane *laryngotracheotomy* is necessary. This consists in dividing the cricoid cartilage and the first ring of the trachea. Below this point there is danger of wounding the isthmus of the thyroid gland and causing profuse hemorrhage. The cricoid and first ring of the trachea are divided either by the scissors, one blade being inserted within the trachea through the incision in the cricothyroid membrane, or the trachea is steadied by the tenaculum and a bistoury is inserted in the wound and made to cut through the cartilage. In adults the cricoid is not infrequently partially ossified, so that a somewhat stout pair of scissors is required to sever it.

The Low Operation.—The incision should extend from the cricoid cartilage to within 1 inch of the sternum. When the skin is divided the transverse fascia will be brought into view. An opening is made in this near the middle of the wound by lifting it up with the dissecting forceps and incising it sufficiently to permit the introduction of a grooved director, which is thrust upward to the upper border of the wound. No vessel of any size being visible over the director, the fascia is incised. This is repeated in the lower half of the wound. The deep fascia uniting the two pairs of muscles, the sternohyoid and sternothyroid, is now brought into view and is treated in the same manner, but care should be exercised in using the knife and grooved director that the cuts in the fascia extend completely to each angle of the wound to prevent it becoming funnel shaped by the time the trachea is reached.

A layer of areolar tissue and fat is now encountered con-

taining many engorged veins. These, if possible, are pushed to one side as the operator proceeds with grooved director and knife to uncover the trachea. If it is impossible to push a vein to one side, two ligatures are passed under it and tied some distance apart, after which the vein is cut.

The wound is now widely opened by means of blunt retractors in the hands of an assistant. Its depth, especially at the lower extremity, may perhaps appall the inexperienced operator, who, however, can assure himself that he has not "missed the trachea" by tracing its course in the wound from above downward with his finger-tip. His fears will be quieted when, after carefully separating the fat and loose connective tissue in the median line, the trachea finally is uncovered, first at the upper end of the wound, where it lies most superficially. In this locality also during the operation will probably appear the isthmus of the thyroid gland. This should be pulled upward out of the way by an assistant or, should that prove impossible, the isthmus can be cut between two ligatures.

The trachea having been reached and the wound dry and free from blood, the tenaculum is inserted in it in the median line near the upper portion of the wound with the point of the tenaculum directed upward. The use of the tenaculum is necessary because of the constant movement of the trachea.

The trachea being steadied by the tenaculum, the point of a bistoury or scalpel is inserted in the trachea in such a manner as to pierce its mucous membrane, but not to cut the posterior wall of the trachea. Cutting carefully and avoiding long sweeps of the knife, which might endanger the posterior wall, three rings are cut, one after the other, with a perceptible snap, yielding in an adult an incision in the trachea about $\frac{3}{4}$ inch in length. The knife is now withdrawn and Delaborde's tracheal dilator (Fig. 166) inserted and opened, widely separating the edges of the tracheal incision.

The moment the trachea is opened, any blood in the wound is sucked into the trachea and immediately violently expelled together with any mucus contained in the trachea.

The lungs then seem to empty themselves of air and the patient stops breathing for a period which may be an anxious one to an inexperienced operator. Finally, a long, deep breath is taken and from then on the respiration is normal. The tracheotomy-tube should now be inserted and be secured by tapes (Fig. 168, B). The upper end of

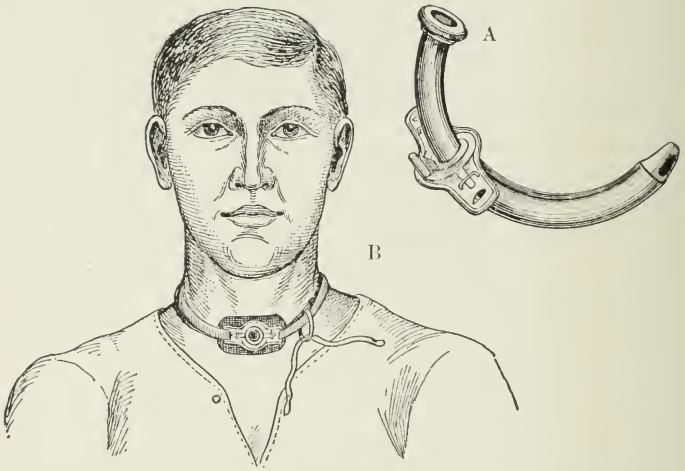


FIG. 168.—Tracheotomy: A, Tracheotomy-tube with pilot; B, tracheotomy-tube in position (Stoney).

the wound is secured by sutures, a portion at least of the lower end being allowed to remain open for drainage. A rectangular piece of iodoform gauze sufficiently large to cover the wound is slit in such a manner that it can be inserted underneath the shield of the tube next the skin, and is held in place by the tape. A handkerchief is tied loosely about the neck in such a manner that a flap falls down over the tube and prevents the entrance of dust and other materials, and also receives secretions which are coughed out through the tube and immediately sucked back into the trachea unless absorbed by the handkerchief or gauze and removed by the attendant. In diphtheria cases the inner tube should be removed and cleansed by the nurse every two hours or oftener should the circumstances require

it. When necessary the outer tube should be removed and cleansed by the surgeon. The reintroduction of the tube is facilitated by the pilot (Fig. 168, A) or by the use of Delaborde's dilator (Fig. 166), one or both of which should be at hand during the after-treatment.

After tracheotomy, during the time the patient is confined to his room, generally a week or two, the air of the room should be kept at a temperature of 80° F. and impregnated with steam from boiling water. In diphtheria cases the steam aids in keeping the secretions moist and liquid and tends to prevent the occurrence of tracheotomy bronchitis or pneumonia.

A liquid diet should be maintained for a few days after the operation.

The wound above and below the tube usually heals rapidly, but exuberant granulations about the tube may require removal by scissors or curet.

THE EAR

ANATOMY OF THE EAR

The ear is divided into the *external* ear, comprising the auricle or pinna and the external auditory canal; the *middle* ear, comprising the membrana tympani, cavity of the tympanum, the mastoid cells, and the Eustachian tube; the

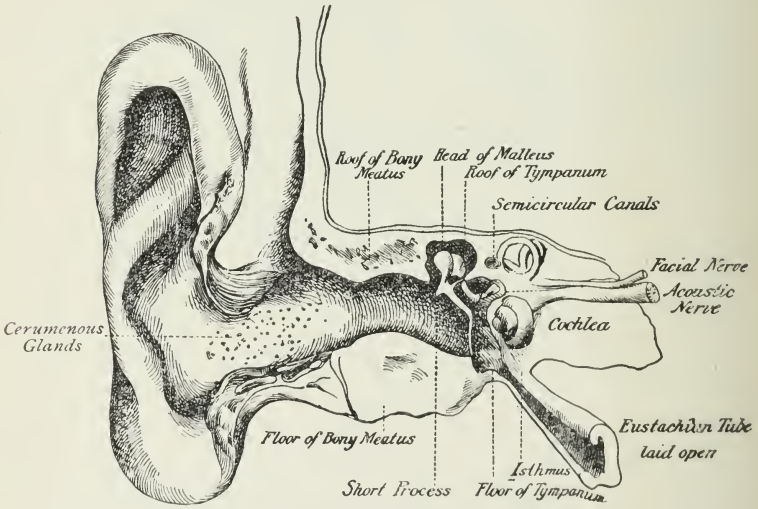


FIG. 169.—Front view of the organ of hearing (Randall).

internal ear or labyrinth, comprising the vestibule, the semicircular canals, the cochlea, and the auditory nerve (Fig. 169).

THE EXTERNAL EAR

The Auricle or Pinna.—The auricle is an irregular mass of reticular cartilage deficient at certain parts, where it is connected by fibrous tissue and muscles. The cartilage is covered by perichondrium, outside of which is firmly adherent skin, containing sweat and sebaceous glands.

The names given to the *elevations* and *depressions* of the pinna are the helix, antihelix, fossa of the helix, fossa of the antihelix, tragus, antitragus, concha, and lobule (Fig. 170).

Muscles of the Auricle.—Those on the *anterior* surface are the tragicus, the antitragicus, the helix major, and the helix minor. Those on the *posterior* surface are the transversus auriculæ and the obliquus auriculæ. Those which connect the auricle with the side of the head and move the pinna as a whole are the attolens, attrahens, and retrahens aurem.

The *lobule* of the ear is the inferior, soft, pendulous part of the pinna, consisting of fat and connective tissue covered by skin (Fig. 170).

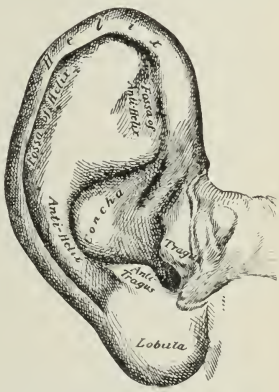


FIG. 170.—Pinna or auricle (Gray).

Vessels and Nerves.—The *arteries* are the anterior auricular branch of the temporal artery; the posterior auricular artery, a branch of the external carotid; and the auricular branch of the occipital artery. Corresponding veins accompany the arteries. The posterior auricular artery is sometimes cut by the first incision in mastoid operations and causes a somewhat profuse hemorrhage, which is readily controlled.

The *nerves* are the auricularis magnus, from the cervical plexus; posterior auricular, from the facial nerve; the auricular branch (Arnold's), from the pneumogastric; the auricular temporal, from the inferior maxillary division of the fifth nerve; and branches from the occipitalis major and minor.

The **external auditory canal** is composed of a cartilaginous and a bony portion. It is about $1\frac{1}{4}$ inches in length, the cartilaginous portion being about $\frac{1}{2}$ inch in length, and forming rather less than one-half the canal, which extends from the concha to the drum-head. The external auditory meatus is lined with a continuation of the skin of the auricle, which within the canal contains hair-follicles

and ceruminous glands. These glands are most numerous at the junction of the cartilaginous and bony portions. The course of the canal is generally described as that of a spiral turned anteriorly inward and downward; but in some individuals the canal is so straight that the drum-head may be inspected by simply illuminating the canal by reflected light.

It should be borne in mind that the auditory canal is narrowest near its central portion, beyond which it again expands into a sort of pouch terminating at the drum-head —an anatomic construction which adds to the difficulties of removing a foreign body should it penetrate beyond the narrowest portion of the canal.

Pressure in front of the tragus usually closes the lumen of the canal; and, owing to this valve-like arrangement, the entrance of foreign bodies into the canal is rendered more difficult. The striking feature of the cartilaginous meatus is the incisuræ Santorini, which completely divide the cartilage into three half rings, united by fibro-elastic tissue.

THE MIDDLE EAR

The **membrana tympani** is a thin, elastic membrane stretched obliquely across the fundus of the external auditory canal in such a manner that its upper and posterior portion is most external. It is divided horizontally by the anterior and posterior folds into two unequal portions—the membrana flaccida or Shrapnell's membrane and the membrana tensor or membrana vibrans (Fig. 171).

Shrapnell's membrane is composed of skin from the auditory canal, and of loose cellular tissue, covered by the mucous membrane of the tympanum, on its inner surface. Bridging a notch in the bony ring, the incisura Rivini, to which it is attached, it passes downward in front of the *attic* or upper chamber of the tympanum. Between Shrapnell's membrane and the neck of the malleus is a pouch or space called "Prussak's space," which sometimes becomes distended with pus during attacks of acute catarrh of the middle ear. Under such circumstances a puncture through Shrapnell's membrane, just above the short process,

will evacuate the pus contained in Prussak's space and relieve the pain.

The *membrana vibrans* or membrana tensor is pearly white in color and is polished on its outer surface. It consists of three layers—a dermic, formed by a continuation of the skin of the auditory canal; a fibrous (membrana propria), consisting of fibers radiating from a point near the center to the circumference, and circular fibers, which are so numerous at the periphery as to form a dense ring around the attached margin of the membrana vibrans and a mucous layer continuous with the mucous membrane of the tympanum. The handle or manubrium of the malleus is fixed between the radiating and circular fibers of the membrana propria. The outer surface of the drum-head faces downward, forward, and outward at an angle of 55 degress with the axis of the auditory canal. Its outer surface is concave. From above, the malleus handle may be seen extending downward and somewhat backward from a tubercle, its short process, and ending near the center of the drum-head at a depression, the umbo. During life, when illuminated, the membrana tympani generally presents a triangular light spot or "cone of light," having its apex at the umbo and extending downward and forward to the periphery (Fig. 171). The mucous membrane of the inner surface of the drum-head is folded upon itself as it passes over the chorda tympani nerve, so that two pouches are formed, opening downward, one in front of and the other behind the manubrium (Fig. 172).

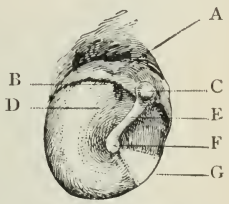


FIG. 171.—Outer surface of the right membrana tympani: A, Membrana flaccida or Shrapnell's membrane; B, posterior fold; C, short process; D, incudostapedial articulation; E, malleus handle; F, umbo; G, cone of light.

Vessels of the Membrana Tympani.—The dermoid layer is supplied with arterioles by the deep auricular branch of the internal maxillary artery; the mucous membrane, by the tympanic branches of the internal maxillary, internal carotid, and stylomastoid arteries.

Nerves of the Membrana Tympani.—To the external layer are distributed filaments from the superficial branch

of the fifth nerve, while the mucous layer is supplied by the tympanic plexus.

The **cavity of the tympanum** is of irregular shape. It measures about $\frac{1}{2}$ inch anteroposteriorly, $\frac{1}{3}$ inch vertically, and $\frac{1}{5}$ inch transversely. It is situated in the petrous portion of the temporal bone above the jugular fossa, having the carotid canal in front, the mastoid cells behind, the auditory canal externally, and the labyrinth internally. It communicates with the pharynx by means of the Eustachian tube and with the mastoid antrum by means of the aditus ad antrum. The upper portion of the tympanum is called the *attic* or recessus epitympanicus. It extends *outward*

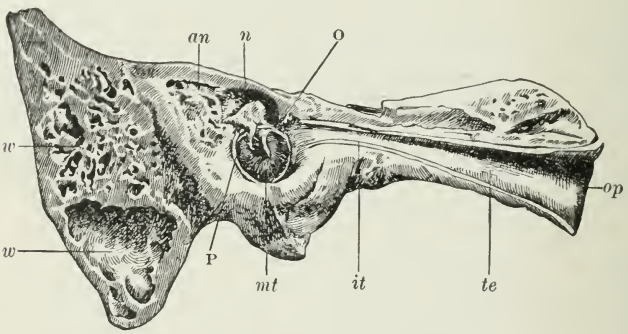


FIG. 172.—Outer half of sagittal section of entire left middle ear : o, Anterior and, p, posterior pouches of von Tröltsch ; *op*, ostium pharyngeum tubæ ; *te*, Eustachian tube ; *it*, isthmus tubæ ; *mt*, membrana tympani, with the malleus and incus and the chorda tympani nerve ; *n*, attic or recessus epitympanicus ; *an*, mastoid antrum ; *w*, *w*, mastoid cells. (Politzer.)

over the auditory meatus, from which it is separated by a wedge-shaped mass of bone, sometimes called the shute. On the shute lie the head of the malleus and body of the incus. The handle of the malleus and long process of the incus descend through the narrow opening from the attic into the *atrium* or lower cavity of the tympanum.

The *roof* of the tympanum consists of a thin plate of bone, the *tegmen tympani*, which separates the tympanic cavity from the meninges of the brain. The *floor* of the tympanum is narrow and separates the cavity of the tympanum from the jugular fossa beneath. Near the inner wall is a small foramen for the passage of Jacobson's nerve.

The *outer wall* consists of the membrana tympani and the bony ring into which it is inserted. In this bony ring, the

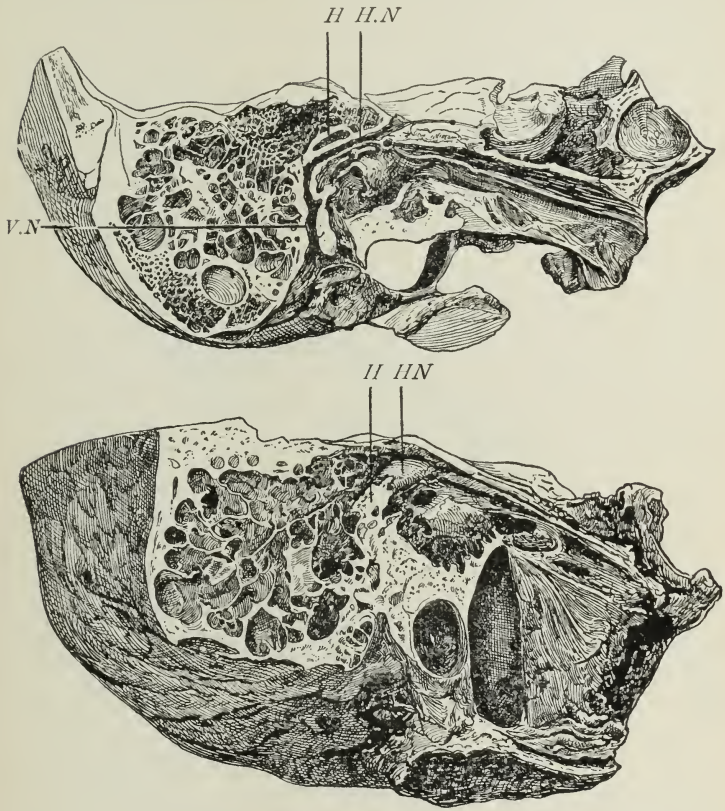


FIG. 173.—Sections through the tympanum parallel to its inner wall; median aspect of the specimens: *H*, Horizontal semicircular canal; *H.N*, horizontal portion of aquæductus Fallopii; *V.N*, vertical portion. In the upper specimen the section is somewhat more median than in the lower, in order to open the horizontal semicircular canal and the aquæductus Fallopii. It will be observed that in the lower specimen the tubercle, *H*, containing the semicircular canal is more lateral than the hard ridges of bones below it, *HN*, containing the facial canal. In the upper specimen the stapes is in the oval window, and the topography of the inner wall of the tympanum, the aditus, and the mastoid antrum is well shown in both specimens. (Author's specimen.)

annulus tympanicus, are two small orifices, the iter chordæ posterius and iter chordæ anterius, for the entrance and exit of the chorda tympani nerve. Just in front of and above

this bony ring is the Glaserian fissure, in which is lodged the long process of the malleus, and which also gives passage to some tympanic vessels and the anterior ligament of the malleus.

The inner tympanic wall (Fig. 173), which is nearly vertical, bulges outward as an eminence, the promontory, corresponding to the first turn of the cochlea. Below, posteriorly, is the niche, at the bottom of which lies the fenestra rotunda or "round window," closed by the membrana tympani secundaria. This membrane is protected by the external wall of the niche, in which it so lies that it is impossible to injure it by means of a straight instrument thrust from without through the membrana tympani. Above, posteriorly, is the fenestra ovalis or "oval window," closed by the foot-plate of the stapes. Above the oval window is the eminence of the aquæductus Fallopii, which transmits the facial nerve. The pyramid is a hollow conic projection containing the stapedius muscle, whose tendon escapes by an opening at its summit.

In the posterior wall above is the opening into the mastoid antrum, the *aditus ad antrum*. The anterior wall separates the cavity of the tympanum from the carotid canal, which lies immediately below and in front of it. In the upper portion of the anterior wall is the orifice of the Eustachian tube. Just above is the canal for the tensor tympani muscle. The Eustachian tube is separated fron the canal for the tensor tympani muscle by a thin bony plate, the *processus cochleariformis*.

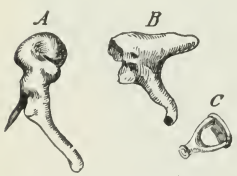


FIG. 174.—The malleus, incus, and stapes of left ear; *A*, Malleus; *B*, incus; *C*, stapes.

The **ossicles** are three small bones so arranged as to form a movable chain connecting the membrana tympani with the fenestra ovalis. These three bonelets are the malleus or hammer; the incus or anvil; and the stapes or stirrup (Fig. 174).

The *malleus* is a somewhat irregularly shaped bone, consisting of an oval head, articulating with the incus; a neck, a short and long process; and a manubrium or handle, imbedded in the membrana tympani. The head and neck

of the malleus, which project into the tympanic cavity, are entirely free from the membrana tympani, the surface of the head, which articulates with the incus, being directed backward. The long and short processes are situated at the junction of the neck and handle of the malleus. The short process pushes the membrana tympani outward before it and is generally plainly visible during life as a tubercle at the upper extremity of the malleus handle. The long process passes forward into the Glaserian fissure, with the under wall of which it unites in adult life. The malleus is held in position within the tympanum by four ligaments—the anterior,

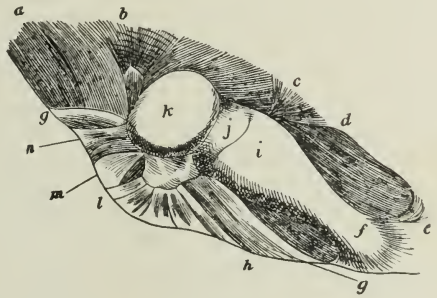


FIG. 175.—Ligamentous support of ossicles, viewed from above: *l–h*, Attachment of the ligamentum mallei externum; *k*, head of hammer; *i*, body of incus; *f*, point of its short process; *a*, entrance to the Eustachian tube from the tympanum; *c*, stapes; *d*, tendon of stapedius muscle; *b*, tendon of the tensor tympani leaving the cochlear process; *g–g*, chorda tympani, marking the free edge of the folds of mucous membrane bounding the pouches; *n*, the upper tendinous fibers of the ligamentum mallei anterius, originating above the spina tympanica major, *m*; *j*, malleo-incudal joint. (Helmholtz.)

superior, external, and posterior. Of these ligaments the anterior is by far the strongest, the posterior and external ligaments being, in a mechanical sense, but one ligament, to which Helmholtz has given the name "axial ligament of the malleus."

The *incus* is the middle one of the three ossicles, its name being derived from the shape of its upper part. This bonelet consists of a body, a short or horizontal process, and a long or descending process. The incus is attached at the extremity of its horizontal process to the posterior tympanic wall by somewhat weak ligaments (Fig. 175). The long process of the incus curves downward, and at first

somewhat outward, toward the auditory meatus, its tip bending sharply inward to articulate with the head of the stapes by means of the lenticular process.

The *malleo-incudal joint* is a ginglymus or hinge-joint, like that of the knee or elbow. The ligaments of the malleus are so arranged that the bone performs the part of a lever whose fulcrum is just below the short process. The manubrium is the long arm of the lever and, consequently, all its movements are repeated in an opposite direction by the head of the malleus. Each inward movement of the membrana tympani and manubrium causes a slight outward movement of the head of the malleus. The incus being also suspended as a lever, when its upper part moves outward with the head of the malleus its long process swings inward and pushes the stapes before it, so that the foot-plate is forced into the oval window.

The *stapes* is the smallest bone in the body. It consists of a head, articulating with the lenticular process of the incus, two branches, or crura, joining the base, which is connected by ligamentous fibers with the margin of the oval window. The stapes (Fig. 174, *C*) measures 4 mm. from its head to the foot-plate, the latter measuring $2\frac{1}{2}$ mm. in its horizontal diameter. The foot-plate of the stapes is somewhat kidney shaped. When in position its long axis is nearly horizontal, with its convex edge looking upward and with its concave edge looking downward. A thin membrane, the ligamentum obturatorium stapedius, stretches across the space between the base and the crura.

Muscles of the Tympanum.—The tensor tympani originates from the under surface of the petrous bone, the cartilaginous Eustachian tube, and its own osseous canal. It is inserted into the handle of the malleus near its root. Its action is to draw the membrana inward and increase its tension. The tensor tympani muscle is supplied by a nerve from the otic ganglion.

The laxator tympani major and minor have already been described as anterior and posterior ligaments of the malleus. The stapedius muscle originates from the interior of the pyramid (Fig. 176) and is inserted into the head of the stapes. Its action is to lift the anterior part of the foot-plate of the

stapes out of the oval window, thus antagonizing to a certain extent the action of the tensor tympani muscle. The stapedius obtains its nerve-supply by a filament of the facial nerve.

Arteries of the Tympanum.—The tympanic branch of the internal maxillary enters the Glaserian fissure and is distributed to the membrana tympani. The tympanic branch of the internal carotid also supplies the membrana tympani. The stylomastoid extends from the posterior auricular to the back part of the tympanum and mastoid cells. The petrosal artery, a branch of the middle meningeal, enters the ear through the hiatus Fallopii, and a branch from the ascending pharyngeal passes up the Eustachian tube.

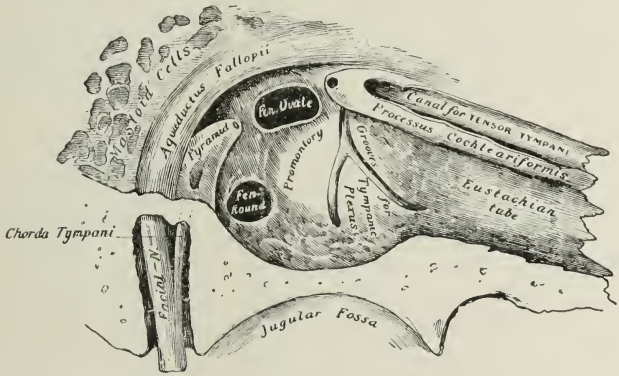


FIG. 176.—Inner wall of tympanic cavity (Gray).

Nerves of the Tympanum.—The tympanic branch of the glossopharyngeal (Jacobson's nerve) supplies the mucous membrane of the tympanum and fenestræ. The tympanic branch of the facial nerve supplies the stapedius muscle and a branch from the otic ganglion supplies the tensor tympani muscle. The chorda tympani nerve passes across the tympanum between the handle of the malleus and the long process of the incus, without branches. It enters the tympanum by the iter chordæ posterius and emerges through the iter chordæ anterius.

The Tympanic Plexus.—Jacobson's nerve (tympanic branch of the glossopharyngeal) divides into three branches, lying

in grooves upon the promontory (Fig. 176). One joins the carotid plexus; a second, the greater superficial petrosal nerve; and a third, passing upward and forward, finally becomes the lesser superficial petrosal nerve.

The **Eustachian tube,** which is about $1\frac{1}{2}$ inches long, passes from the middle ear downward, forward, and inward to enter the pharynx. It affords communication between the air in the pharynx and that contained in the middle ear. The outer third consists of bone, commencing at the lower part of the anterior tympanic wall, and gradually narrowing to terminate at the angle of junction of the petrous and squamous portions of the temporal bones. The inner two-thirds of the Eustachian tube consist of elastic cartilage and fibrous tissue, which unite the inferior portion of a curved cartilaginous plate so as to form a tube. The mucous membrane lining the Eustachian tube is a continuation of that of the pharynx and is covered with stratified ciliated epithelium.

The *muscles that dilate the Eustachian tube* are the levator palati muscle, which, arising from the petrous bone and cartilaginous portion of the tube, is inserted into the tissues of the soft palate, and the tensor palati, a flattened muscle which, arising from the sphenoid bone and the cartilaginous tube, passes as a broad tendon around the hamular process to form the broad aponeurosis of the soft palate. The action of both these muscles is to dilate the tube. Some of the fibers of the tensor tympani and tensor palati are blended, and an aponeurotic connection always exists along the Eustachian tube, so that probably these two muscles have no action entirely independent of each other. When the soft palate is drawn upward the membrane is also retracted by the tensor tympani and the Eustachian tube is at the same time dilated, so that, although a current of air enters the tympanum, it is prevented from forcing the membrane too far outward and interfering with the equilibrium of auditory tension. The tensor tympani and tensor palati receive nerve-filaments from the otic ganglion, but the levator palati is supplied by a branch from Meckel's ganglion.

The Eustachian tube receives its *arterial supply* by the

following arteries: The ascending pharyngeal, branches from the middle meningeal and internal maxillary, and a branch from the stylomastoid artery.

Its *nerves* are, in addition to those supplying muscles of the tube, derived from the fifth and seventh pair and the glossopharyngeal.

The Mastoid Process of the Temporal Bone.—At birth the mastoid process consists of a small flattened tuberosity containing but one cell and that of considerable size—the *mastoid antrum.* At puberty the mastoid process has become a distinct prominence, conic in shape, with its apex downward. The substance of the mastoid process consists of small cavities varying greatly in number, size, and shape in different individuals. Some of them communicate with each other and are lined with a continuation of the mucous membrane of the tympanum, which is here covered by squamous epithelium.

THE INTERNAL EAR OR LABYRINTH

Osseous Boundaries.—At all points the various channels and cavities of the labyrinth are deeply imbedded in the petrous portion of the temporal bone. The bony labyrinth consists of a central cavity, called the "vestibule," from the walls of which spring, like arches, the semicircular canals, while through the anterior wall of the vestibule a canal leads into the snail-shaped cavity of the cochlea (Fig. 177).

Contents of the Osseous Labyrinth.—The vestibule contains fluid and two distinct membranous sacs, the utricle and saccule (Fig. 178). The saccule communicates with one of the membranous tubes of the cochlea, the ductus cochlearis, by means of a slender membranous tube, the canalis reuniens, while the cavity of the utricle is continuous with that of the membranous semicircular canals, so that the membranous labyrinth may be said to consist of a system of cavities with membranous walls containing a fluid, the endolymph, and nearly surrounded by another fluid, the perilymph.

A diaphragm, consisting partly of bone (lamina spiralis ossea) and partly of membrane (membrana basilaris), divides the cavity of the cochlea into an upper and lower space of

nearly equal size (Fig. 179). The upper, the scala vestibuli, communicates with the cavity of the vestibule, and the lower, the scala tympani, ends abruptly at the round window. The upper space (scala vestibuli) is divided by a diaphragm (Reissner's membrane) placed at an angle of 45 degrees with the membrana basilaris, into the scala vestibuli proper and the scala media or ductus cochlearis, which, as already described (Fig. 178), communicates with the saccule by means of the canalis reuniens. The scala media or ductus cochlearis contains endolymph and the organ of Corti (Fig. 180).

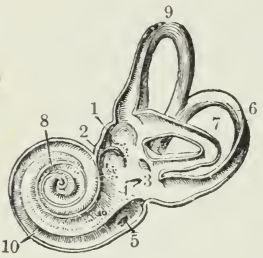


FIG. 177.—The bony labyrinth laid open: 1, Recessus ellipticus for utricle; 2, recessus sphæricus for saccule; 3, recessus cochlea; 4, pyramis vestibuli; 5, round window; 6, posterior semicircular canal; 7, external semicircular canal; 8, cupola of the cochlea; 9, superior semicircular canal; 10, lamina spiralis ossea projecting from the modiolus into the calibre of the canal of the cochlea, and terminating in the cupola as a hook-like process called the "hamulus."

The **organ of Corti** rests upon the membrana basilaris about midway between the lamina spiralis ossea and the

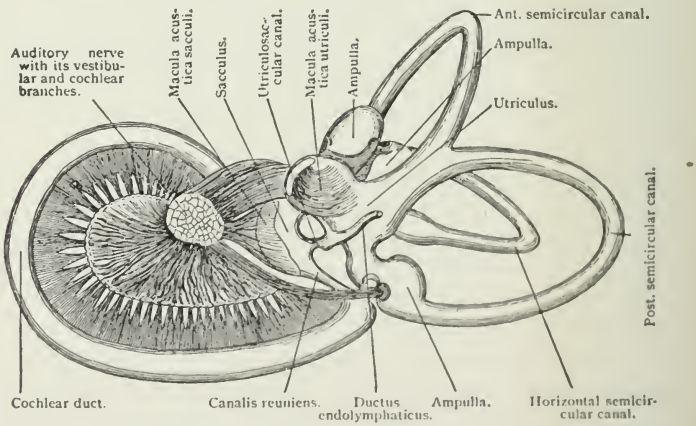


FIG. 178.—Membranous labyrinth of the right ear from five-months'-old human embryo (from Schwalbe, after Retzius).

outer wall of the ductus cochlearis. It extends from the vestibule to the cupola of the cochlea, and to it are distrib-

uted nerve-fibers from the cochlear branch of the auditory nerve. Corti's organ is made up of a nearly central arch,

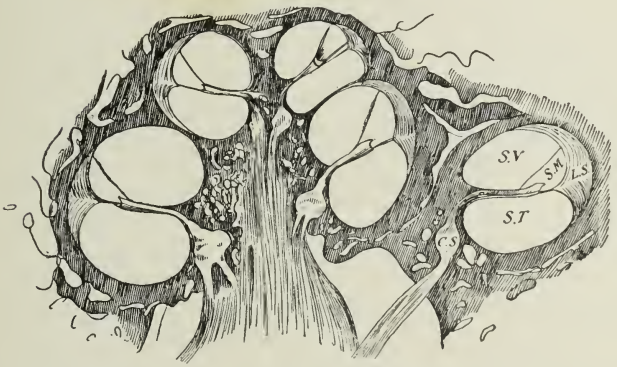


FIG. 179.—Longitudinal section of the cochlea, showing the relations of the scalæ, the ganglion spirale, etc.; *S.V*, Scala vestibuli; *S.T*, scala tympani; *S.M*, scala media; *L.S*, ligamentum spirale; *G.S*, ganglion spirale. (Gray.)

formed by the inner and outer rods or pillars of Corti (Fig. 180), the bases of which are farther apart as the organ of Corti ascends from the vestibule to the cupola. There are

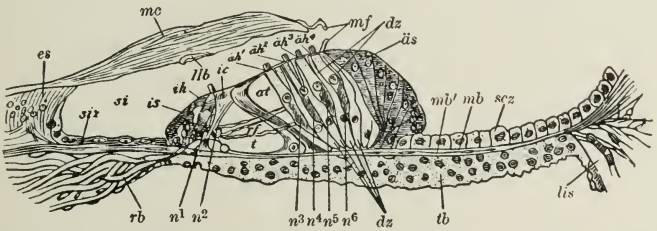


FIG. 180.—Transverse vertical section of Corti's organ of a man twenty-nine years old: *es*, Limbus laminæ spiralis; *mc*, membrana tectoria; *Hb*, Hensen's striæ; *mf*, fibers of attachment of the membrana tectoria to the zona tecta; *si*, sulcus spiralis; *siz*, epithelium of the sulcus spiralis; *is*, inner supporting cells; *ic*, inner rod cells in connection with the outer rod cells, between which is seen the tunnel (*t*) of Corti; *ih*, inner hair-cell; *äh*¹–*äh*⁴, outer hair-cells; *dz*, Deiters' cells; *äs*, Hensen's supporting cells; *rb*, nerve-fibers of the ramulus basilaris; n^1–n^6, outer bundles of the spiral nerve-fibers; *rf*, radiating tunnel fibers; *at*, inner part of Nuel's space; *mb*, upper layer of the membrana basilaris; *mb'*, lower layer of the membrana basilaris; *th*, layer covering the tympanic surface of the membrana basilaris; *lis*, ligamentum spirale. (Gruber, after Retzius.)

at the outside of the arch four rows of ciliated cells and at the inner side one row, which receive terminal filaments from the cochlear branch of the auditory nerve. The

name "hearing cells" is sometimes applied to these hair-cells. There is a peculiar fenestrated membrane, the lamina reticularis, into whose net-like structure project the cilia of the outer hearing cells, which are covered and protected by a glue-like substance, the membrana tectoria. The rods of Corti have been estimated at about 10,500, while the number of hair-cells is estimated to be about 21,300.

The **membranous semicircular canals** occupy scarcely one-third of the space inside the bony canals, except at the ampullæ, where they hug the bony walls more closely. The space between the membranous canals and the bony wall is occupied by connective tissue rich in blood-vessels rather than with free fluid, as in the cochlea (Fig. 181).

The **otoliths** are granular, amorphous, sometimes crystalline particles found along the walls of the utricle, saccule, ampullæ, membranous canals, on the periosteum of the osseous semicircular canals, and in the fluid of the cochlea. They consist of about 75 per cent. mineral matter, mostly carbonate of lime, and organic material resembling mucus in its physical and chemic characteristics. The function of the otoliths has not been determined, but it has been suggested that they exert a damping action upon the vibrations of the terminal fibers of the hair-cells. In some of the lower animals they are huge in size compared with those of man and assume fantastic shapes.

The **auditory nerve** originates by three fasciculæ from the superior vermiformis process of the cerebellum and from the inner and outer nuclei, formed chiefly by the gray substance of the posterior pyramid and restiform body. The nerve emerges, superficially, from a groove between the olivary and restiform bodies at the lower border of the pons. At the bottom of the internal auditory canal it divides into the cochlear and vestibular divisions, both of which contain ganglion cells. The cochlear nerve divides into numerous filaments to enter the modiolus and sends branches to each of the hair-cells (Fig. 180). The vestibular nerve divides into three branches: The filaments from the upper branch enter the vestibule through the macula cribrosa at the bottom of the internal meatus, and are distributed to the utricle and the ampulla of the external and

superior semicircular canals; the middle branch is distributed to the saccule, and the inferior branch passes to the ampulla of the posterior semicircular canals.

Function of the Semicircular Canals.—They appear to be a peripheral space-organ, and through centers in the brain regulate the movements of the muscles of the eye and probably all the muscles of the body for the preservation of equilibrium. The power of maintaining equilibrium is derived from the education of touch and sight and information derived from the peripheral space-organ within the ear, which informs the brain of the position of the head and regulates the movements of the muscles for the preservation of equilibrium. If pressure be made upon the membrane of the round window, dizziness and an inclination to fall backward are produced as the result of the pressure transmitted to the ampulla of the posterior canal. If the foot-plate of the stapes be pressed upon, a rocking sensation of the head from side to side will be felt, indicative of the transference of the pressure to the ampulla of the superior canal. It is impossible to transmit pressure to the fluid of the horizontal canal, and when strong pressure is made upon the fluid within the vestibule there is produced dizziness without sensation of falling in any especial direction.

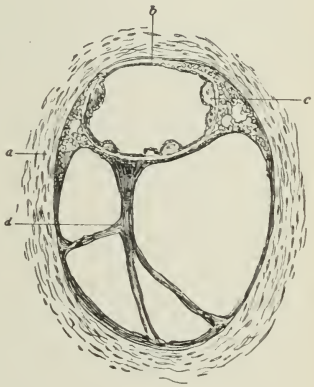


FIG. 181.—Section through the osseous and membranous semicircular canals: *a*, Osseous semicircular canal; *b*, place of attachment of the membranous semicircular canal; *c*, elevations on the inner surface of the membranous semicircular canal; *d*, vascular bands of connective tissue. (Politzer.)

Functions of the Vestibule and Cochlea.—Except that in a general way the vestibule and cochlea have to do with the sense of hearing, the functions of these parts of the ear are not clearly understood. It is supposed that the individual hair-cells and rods of Corti vibrate to single tones, and that a compound sound causes the vibration of a number of hair-cells proportionate to its composite character.

TESTS FOR HEARING

Hearing is the faculty of the perception of sound.

Sound is a peculiar sensation excited in the organs of hearing by the vibratory motion of bodies, the effects of which are transmitted to the ear through an elastic medium.

Sound is a sensation and should be distinguished carefully from the vibrations that produce it; which vibrations, of course, may exist without the presence of an organized being to perceive them.

Sources of Sound.—Sound is produced by the rapid vibrations that take place in the molecules of bodies when they are disturbed by shock or by friction. When a resonant body is struck its molecules alternately approach and recede from one another with a velocity and amplitude of vibrations corresponding to the form, size, and molecular composition of the body; and this motion is transmitted by contact to any surrounding elastic medium, such as air. Sound-waves so produced are in part reflected in passing from a rarer to a denser medium, as, for example, when passing from air into water. If, however, a tense membrane, free to vibrate, is interposed between the air and any fluid or solid medium, the aërial vibrations are not reflected, but are transmitted into the more solid medium with little loss of their intensity. But for the membranes of the middle ear, sound-waves transmitted from the ear to the lymph of the labyrinth would lose intensity to such a degree as to be inaudible.

Acoustics is that department of physics which treats of sounds. A rudimentary knowledge of the laws of acoustics is essential to an understanding of the physiology of the ear.

The **science of music** treats of a peculiar class of sounds and combination of sounds calculated to produce pleasurable emotions. Such sounds are distinguished from noises, which are sounds either of very short duration, like the reports of firearms, or are a mixture of many discordant sounds.

Pendulum Vibration.—If a needle be attached to one arm of a vibrating tuning-fork, and if in contact with the end of the needle a piece of smoked paper be moved at a uniform velocity, a tracing of the vibrations of the needle will be

scratched upon the paper (Fig. 182). This tracing is a record of the *number* of vibrations of the fork during a given time and of the *amplitude* of the vibrations. The record is regular and uniform, and so similar to that produced by a pendulum under similar circumstances that Huxley has described this form of vibration under the name of *pendulum vibration*.

A *tone* is a sound produced by a simple pendulum vibration. It has the characteristics of quality or "timbre"; intensity, volume or loudness; and pitch (high or low tone).

The *quality* of a tone depends largely upon the *material* of the substance which produces the tone. The quality of the note emitted by striking a strip of wood is entirely different as regards its quality or "timbre" from that produced by striking a rod of metal. A note produced from an organ, a violin, and a cornet may in each case have the same pitch

FIG. 182.—Tracing on smoked paper produced by the vibrations of a tuning-fork.

and volume, but will differ widely from one another as regards quality or timbre.

The *intensity* of a tone depends upon the force and amplitude of the vibrations which produce it. When a tuning-fork is first made to vibrate, its tone is comparatively intense or loud, because the force and amplitude of its vibrations are comparatively great, but as it continues to vibrate its tone is heard less and less distinctly, because the force and amplitude of its vibrations are becoming less and less. The pitch of the tone, however, remains the same until the fork ceases to vibrate.

The *pitch* of a tone depends upon the rapidity of the vibrations that produce it. The more rapid the vibrations, the higher the pitch. The human ear is generally able to distinguish the tone produced by a tuning-fork vibrating only 16 times during a second, and also that of a fork vibrating 38,000 times a second. The capacity, however, to

distinguish sounds of very low or very high pitch varies greatly in individuals, but the ears of most persons are more sensitive to sounds of low than to those of high pitch. Prof. Tyndall says : " The squawk of the bat, the sound of the cricket, even the chirp of the common house-sparrow, are unheard by some persons who for lower sounds possess a sensitive ear."

The inability to hear high notes increases with age, and generally also as the result of disease of the labyrinth or acoustic nerve ; and in testing the acuteness of hearing by means of tuning-forks and Galton's whistle it is well to bear this fact in mind. For careful tests as to the sensitiveness of the perceptive apparatus it is well for the aurist to be provided with at least five forks, the lowest (c_{-2}) giving 32

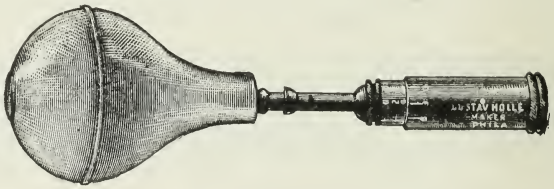


Fig. 183.—Galton's whistle with rubber bulb. The pipe below the opening is filled by a plunger advanced or withdrawn by a screw, each turn being shown by the scale upon the enlarged tube, and its tenths by that on the revolving collar. It gives an audible sound from 0.5 (theoretically, 84,000 v. s) to 10 or 12 (4200 or 3500).

vibrations during a second and the highest (c_1) yielding 2048 vibrations in a second. Galton's whistle (Fig. 183) and König's rods will be found useful also for making tests of this kind. *König's rods* are ten steel cylinders, 20 mm. in diameter, suspended by cords attached to them at a distance from each end of one-fifth of the length of each rod. The rods are of such a length that when struck with a hammer they produce tones, the lowest of which give 4096, and the highest 32,768, vibrations per second.

Galton's whistle for testing the higher tones of the scale is more convenient than König's rods. It consists of a metal tube so perforated as to cause a whistle when air is blown through it by means of a rubber bulb attached to the proximal extremity of the instrument. The distal extremity is closed by a metal rod capable of being moved backward

and forward within the tube by a micrometer screw. The length of the column of air within the tube beyond the perforation, and consequently the pitch of the note emitted by the whistle, are determined by the position of the rod within the tube. The micrometer screw is graduated to indicate single numbers, while on the side of the tube is a scale to show tens; so that by turning the micrometer screw the metal rod within the hollow cylinder can be placed in any position indicated by a number on a scale having a range of from 1 to 120. The following table indicates the number of vibrations per second of the note emitted by the whistle corresponding with the numbers on its scale:

Vibration per second	84000	56000	42000	33600	28000	24000	21000	18666
Scale	10	15	20	25	30	35	40	45
Vibration per second	16800	15273	14000	12923	12000	11200	10500	9820
Scale	50	55	60	65	70	75	80	85
Vibration per second	9330	8842	8400	8000	7591	7305	7000	
Scale	90	95	100	105	110	115	120	

Helmholtz states that the human ear is able to distinguish as musical notes tones lying between 16 and 38,000 vibrations per second, or a range of about 11 octaves, but that the lowest note used in orchestral music is E^{-2} or one of 40 vibrations per second. In pianos the lowest note in general use is c_{-2}, 32 vibrations per second; and the highest, 7 octaves above it, is c_5, 4096 vibrations during a second. The following table is from Appun:

$C^{-2}=32$	$D^{-2}=36$	$E^{-2}=40$	$F^{-2}=42{,}_{66}$	$G^{-2}=48$	$A^{-2}=53{,}_{33}$	$H^{-2}=60$
$C^{-1}=64$	$D^{-1}=72$	$E^{-1}=80$	$F^{-1}=85{,}_{33}$	$G^{-1}=96$	$A^{-1}=106{,}_{66}$	$H^{-1}=120$
$c=128$	$d=144$	$e=160$	$f=170{,}_{66}$	$g=192$	$a=213{,}_{33}$	$h=240$
$c^1=256$	$d^1=288$	$e^1=320$	$f^1=341{,}_{32}$	$g^1=384$	$a^1=420{,}_{66}$	$h^1=480$
$c^2=512$	$d^2=576$	$e^2=640$	$f^2=682{,}_{64}$	$g^2=768$	$a^2=853{,}_{32}$	$h^2=960$
$c^3=1024$	$d^3=1152$	$e^3=1280$	$f^3=1365{,}_{28}$	$g^3=1536$	$a^3=1706{,}_{64}$	$h^3=1920$
$c^4=2048$	$d^4=2304$	$e^4=2560$	$f^4=2710{,}_{56}$	$g^4=3072$	$a^4=3413{,}_{28}$	$h^4=3840$
$c^5=4096$	$d^5=4608$	$e^5=5120$	$f^5=5421{,}_{12}$	$g^5=6144$	$a^5=6826{,}_{56}$	$h^5=7680$
$c^6=8192$	$d^6=9216$	$e^6=10240$	$f^6=10842{,}_{24}$	$g^6=12288$	$a^6=13653{,}_{12}$	$h^6=15360$
$c^7=16384$	$d^7=18432$	$e^7=20480$	$f^7=21684{,}_{48}$	$g^7=24576$	$a^7=27306{,}_{24}$	$h^7=30720$

Harmony.—If the rates of vibration in a second of two notes simultaneously produced stand to each other in the ratio of simple multiples, so that while the low note makes 1 vibration the high note makes 2, 3, 4, etc., the notes are said to be in harmony or concord, and the result is consonance. These are the ratios of the human voice in ordinary speaking or singing, and, according to Wolf,

speech has a compass of 5 octaves, from c to c_5. The simplest ratio is $\frac{2}{1}$, and to this the name *octave* is given. In this case the higher note has double the number of vibrations of the lower. The ratio of the notes in the diatonic major scale is as follows:

C.	D.	E.	F.	G.	A.	B.	C.
1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	$\frac{1}{2}$

The *tuning-fork* used to test the hearing should be large enough to secure sufficient intensity or loudness of tone. It is not absolutely necessary, but desirable, to have the

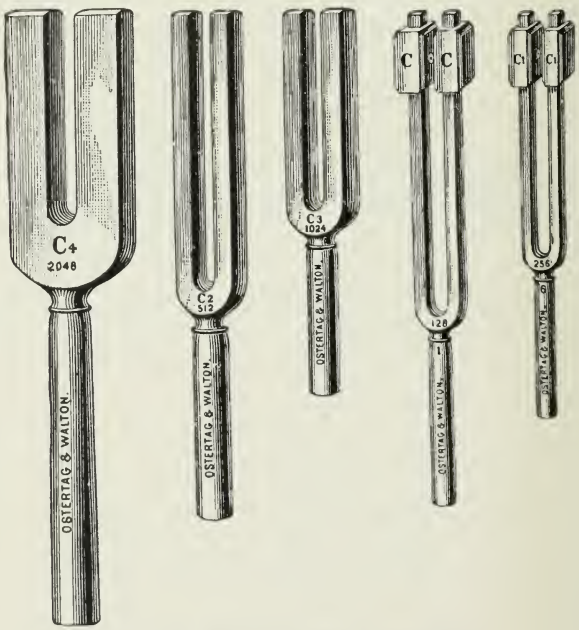


FIG. 184.—Hartmann's set of tuning-forks.

tuning-fork provided with movable clamps, so as to deaden overtones. While it is more convenient, as stated, for the aurist to be provided with at least five forks of different pitch, yet one sounding the note c_2 (512 vibrations per second) will generally answer the purpose of ordinary

clinical investigations. It is convenient to have at hand a small tuning-fork emitting a tone of feeble intensity (Fig. 185), in order to confine the sound to one ear; because when a very heavy tuning-fork is employed in examining patients whose hearing is greatly impaired only in one ear, it is impossible to be certain that the sound of a large fork is not heard by the ear in which the hearing is better. When the fork is used for testing the hearing of the ear in which the hearing is more deficient, a large fork, provided with movable clamps, can, however, generally be made to answer the same purpose by placing the clamps sufficiently low down upon the tines of the instrument.

Fig. 185.—Small tuning-fork.

Weber's Test.—E. H. Weber demonstrated that when a vibrating tuning-fork is placed against the teeth or on a point of the cranium the tone is heard better by a person with normal hearing if the ears are closed by the fingers. If only one ear is closed, the fork is heard best in that ear. Weber, Rinne, and Toynbee attributed this phenomenon to increased resonance; Mach, to the obstruction of the outlet of sound-waves through the auditory canal. Probably each of these factors should be given due weight as a cause of the phenomenon.

It should be borne in mind that any obstruction to the exit of sound-waves from the middle ear when a tuning-fork is vibrating with its handle in contact with the teeth or at a point upon the cranium midway between each ear, will cause the sound of the fork to be heard most distinctly in the obstructed ear. The cause of obstruction may be impacted cerumen in the external auditory meatus, occlusion of the Eustachian tube, mucus within the tympanum, or thickening of the membrana tympani as the result of catarrh of the middle ear. Hence, if a patient is deaf in only one ear from any of these causes, a vibrating tuning-fork, with its handle in contact with the teeth or on a point on the cranium midway between the ears, will be heard by him *better in the deaf ear*. If, however, the hardness of hearing

is due to impairment of the labyrinth or of the auditory nerve, the note of the tuning-fork will be heard *less distinctly in the deaf ear.*

In practising Weber's method of examining the hearing, the observer should bear in mind that the answers of some patients will largely be determined by their imagination, and that they at first will say that they hear the sound of the fork most distinctly in that ear in which the hearing is better, simply because *they think they should do so.* The test should be repeated sufficiently often to convince the observer that his patient's answers are reliable. It will, in all instances, be judicious to request the patient, while the fork is still vibrating upon the cranium, to close first one ear and then the other with a finger, and only after this has been done to ask him in which ear he now hears the sound of the fork most distinctly.

Rinne's Test.—Rinne observed that when a vibrating tuning-fork, with its handle in contact with the tissues over the mastoid process, ceased to be heard, the sound of the fork reappeared if it was held in front of the ear. *Aërial conduction is superior to tissue-conduction in individuals with normal ears.* If the tuning-fork is heard best by aërial conduction, the fact may be noted as Rinne+; or Rinne− if the contrary is the case; or, to be more exact, the number of seconds that the tuning-fork is heard upon the mastoid and in front of the auditory meatus may be given in the form of a fraction, the numerator of which will be less than the denominator if Rinne's method yields a positive result, and the contrary will be the case if Rinne's method gives a negative result. Thus, if the note of a c_2 tuning-fork whose handle is in contact with the mastoid process is heard for twenty seconds, and for fifty seconds when its tines are held close to the external auditory meatus, the fact may be noted thus: Rinne $+\frac{20}{50}$. If, however, the fork is heard for thirty seconds when its handle is in contact with the tissues over the mastoid process, and only ten seconds when its prongs are held close to the meatus, the fact should be noted as Rinne $-\frac{30}{10}$ (R. $-\frac{30}{10}$). In the first instance any hardness of hearing is due to impairment of the nervous part of the ear; in the latter case it is due to the result of

disease or to imperfection of the external or middle ear, or both.

It is a well-known fact that any rigidity of the conducting apparatus so alters the relation of tissue to aërial conduction that the former finally exceeds the latter. This change begins with the low notes. If Rinne's method be employed on a patient in whom there is only a slight impairment of the patency of the Eustachian tubes, with congestion of the mucous membrane of the tympanum, the result will be negative with forks emitting a very low-pitched note and positive for that of a higher pitch. That is, the sound of the fork of low pitch will be heard louder and longer when its handle is firmly pressed upon the mastoid process than when the tines of the fork are held in front of the meatus. This, however, will not be the case if a fork emitting a high-pitched tone be employed. In conditions in which there is great rigidity of the transmitting apparatus of the ear, the receptive apparatus remaining healthy, Rinne's test will yield a negative result with forks of high as well as low pitch. Generally under such circumstances tissue-conduction will be apparently increased; that is, a tuning-fork with its handle pressed upon the tissues over the mastoid will be heard louder and longer than normal. When, instead of this being the case, tissue-conduction as well as aërial conduction is decreased, impairment of the functions of the internal ear should be suspected, although it should be borne in mind, when testing the hearing of patients past middle life, that tissue-conduction of sound is always decreased as the result of senility, and sometimes as the result of other causes besides disease of the internal ear.

In any case, however, in which the acuteness of hearing is reduced to the perception of words spoken in a loud voice close to the ear, if tissue-conduction is greater than aërial conduction only for forks of low pitch (C_1 to c) while those of high pitch (c_3, c_4) are heard very imperfectly, if at all, either by aërial or tissue-conduction, the receptive apparatus, as well as the middle ear, is impaired. In such cases, although the tension of the structures of the middle ear can doubtless be removed by operative procedures, the performing of such an operation will not result in a great improvement in the patient's hearing.

Schwabach's Test.—This test consists in comparing the number of seconds a tuning-fork is heard on the mastoid and at the meatus in a normal ear with the time the fork is heard in these positions by the ear being examined.

Gelle's Test (Pressions Centripetes).—If the air within the auditory canal be compressed by means of Siegle's speculum or any suitable instrument, a normal ear will hear the sound of a tuning-fork vibrating on the cranial bones with diminished intensity. This phenomenon is due to increased labyrinthine pressure, because when the air within the auditory canal is condensed the chain of bonelets with the foot-plate of the stapes is pressed inward. If ankylosis of the stapes exists or if there is great immobility of the ossicles the tone of the tuning-fork will remain unchanged during the test, while if the labyrinth is diseased and the stapes is movable the application of Gelle's test will produce dizziness.

Bing's Test.—If a tuning-fork is vibrated upon the mastoid process of a normal ear, after its sound is no longer audible it can be made to reappear if the meatus is tightly closed with the moistened finger. In cases of severe deafness, according to Bing, if this test yields a negative result, the hardness of hearing is due to a middle-ear affection, while if the result of the test is positive, the deafness is the consequence of a labyrinthine affection.

Dr. Bing uses also, as an aid to diagnosis, what he terms the "entotic" use of the speaking-trumpet, which consists in speaking into a speaking-tube connected by means of an air-tight joint with a catheter introduced into the mouth of the Eustachian tube. If the voice is heard better by this method than when the speaking-tube is used in the external meatus, there is hindrance to sound-conduction at the malleus or the incus, and the foot-plate of the stapes is freely movable in the oval window.

To **test the hearing by a watch** the patient should be seated with his face so covered by a napkin or towel that it is impossible for him to see the watch, because many patients imagine that they hear a watch which they see held close to their ear. It is well also to request the patient to close firmly with his forefinger the ear that is not being tested. The aurist should hold the watch in his hand with its case open close

to the patient's ear until the latter hears it distinctly, then move his hand to a considerable distance and slowly bring the watch toward the ear being examined, observing the exact distance the watch is when *first* heard. The result of the examination may be expressed by a fraction, the numerator of which is the distance at which the patient hears the watch and the denominator the distance at which the watch can be heard by a normal ear. For example, if the watch used in making the test is heard by a normal ear at 40 inches, and the patient hears it only at 15 inches, the fact may be recorded thus: Hearing for watch is $\frac{15}{40}$ (H. W.$=\frac{15}{40}$). If the watch is heard only on contact with the auricle, the record should read, Hearing for watch is $\frac{\text{contact}}{40}$; or, if it is only heard by exerting considerable pressure with it upon the auricle, Hearing for watch is $\frac{\text{pressure}}{40}$.

The room in which the hearing is being tested by the watch should be as free from noise as possible, and the watch should invariably be made to approach the patient's ear from a distance as directed above, and the point be noted at which it is *first heard*, because, while the patient still hears the watch if it is slowly carried away from his ear, it will be found that he will continue to hear it at a much greater distance than that at which he would *first hear* it if it were made to approach his ear from a distance. The hearing may be tested in a similar manner by means of the acoumeter, an instrument devised by Politzer. The acoumeter gives the note c with about the same loudness as the sound of a loud-ticking watch.

In **testing the hearing by the voice** the patient should close the ear not being tested firmly with his forefinger, and either close his eyes or look in such a direction that it will be impossible to see the motion of the aurist's lips; the distance in feet should then be observed at which words are heard when spoken in a whisper, ordinary conversational tone, or a loud voice if the patient be very deaf. In making this test of the hearing-power it is best, in most instances, to employ single words of only one syllable. The result of the examination may be noted as a fraction, the numerator of which is the distance in feet at which the patient hears the words

and the denominator the distance in feet at which a normal ear can hear the same words. For example, if the patient hears whispered words 3 feet from his ear, and should hear them at 10 feet, the fact may be recorded thus: Whisper $\frac{3}{10}$.

PATHOLOGIC CONDITIONS OF NOSE AND PHARYNX CAUSING DISEASE OF EAR

As the result of long-continued chronic nasopharyngeal catarrh the Eustachian tubes and middle ear become affected in a proportion of cases. Especially if the catarrh be of the hypertrophic variety, so that nasal respiration is interfered with by the presence of anterior and posterior hypertrophies, ecchondroses or exostoses from the septum, etc., is disease of the Eustachian tubes prone to result. The same is true of a deflection of the septum sufficiently great to cause marked obstruction of one nostril. In many instances catarrh of the Eustachian tube and middle ear is the result of the extension by continuity of surface of a similar affection of the nasopharynx. However, when one or both nasal chambers are obstructed other causes probably bring about the same result. Posterior to the obstruction, in nearly all cases of nasal stenosis, a partial vacuum is formed during inspiration; as the result, the nasal mucous membrane is constantly engorged with blood in this locality. This condition may extend back far enough to involve the pharyngeal mouth of the Eustachian tube. Probably most cases of one-sided deafness on the same side as an obstructed nostril may be explained in this manner. The hearing in such cases frequently improves rapidly after the removal of the nasal stenosis, but a posterior hypertrophy may be so situated as to produce venous stasis in that locality. By far the commonest cause of Eustachian salpingitis, in children at least, is hypertrophy of the pharyngeal tonsil. When the adenoid overgrowth is situated so as to interfere with the return of blood from the mucous membrane of the Eustachian tubes, stenosis results because of engorgement and inflammation, and the hearing deteriorates more and more as the result of each succeeding attack of coryza. Under such circumstances, if the hypertrophy has not

existed too long, a complete restoration of the hearing may be expected to follow the removal of a portion of the hypertrophied gland. However, it must not be supposed that by removing the nasal disease which produced the aural affection a complete restoration of the hearing will result in every instance. In most cases of this kind careful treatment of the tubal or middle-ear disease is *absolutely necessary*.

The **pharyngeal mouths of the Eustachian tubes,** bordered by their cartilaginous lips, appear as crater-shaped elevations in front of Rosenmüller's fossa. The mucous membrane at the entrance of the tube is, in the normal state, paler than that in its vicinity, which is of a deep-red color over the cartilaginous lips. In atrophy of the tube-mouths the mucous membrane covering the lips of the tube is pale in color and the parts appear shrunken. In catarrh of the Eustachian tube the mouth of the tube will sometimes appear dilated by a mass of mucus exuding from it, and under such circumstances the tube-mouth is generally greatly swollen.

Patency of Eustachian Tubes.—The methods most commonly used to test the patency of the Eustachian tubes and introduce air into the middle ear are Valsalva's, Politzer's, and catheterization of the Eustachian tubes.

Valsalva's method consists in a forced expiration, the mouth and nose being closed. In this method air is forced from the pharynx through the Eustachian tubes into the middle ear. If the aurist examines the membrana tympani while the patient inflates the middle ear by Valsalva's method the drum-head will be observed to move outward, and in most instances it will become slightly congested. If an aural stethoscope be used a slight noise will be heard as the air enters the patient's middle ear.

The *aural stethoscope* or *auscultation-tube* consists of about 3 feet of thin rubber tubing into the ends of which appropriate ear-pieces are inserted. One ear-piece should be of white bone for the aurist's own ear, and the other end of hard rubber, to be inserted into the auditory canals of his patient's ears. In using the aural stethoscope for the auscultation of the right ear of a patient the aurist should

first insert the white end-piece into his own right ear. The patient is then instructed to place the hard-rubber ear-piece loosely in his ear and hold it in position with his thumb and finger.

In *Politzer's method* the patient is directed to hold a small quantity of water in his mouth until he is told to swallow. The aurist then takes the nose-piece of Politzer's air-bag (Fig. 187) between his thumb and finger and inserts it into one of the patient's nostrils, and closes both nostrils firmly about the nose-piece by pressure with his middle finger and forefinger. The patient is then told to swallow; as the patient's larynx is seen to rise at the commencement of the act of swallowing the aurist quickly compresses the air-

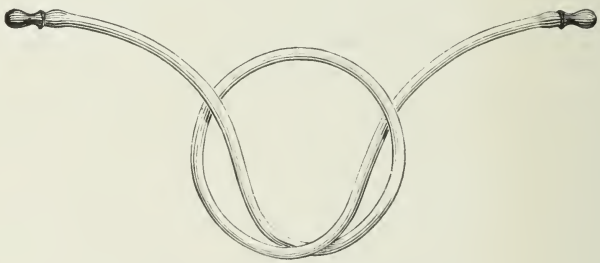


FIG. 186.—Toynbee's auscultation-tube.

bag held in his right hand, thus forcing air through the nose and Eustachian tubes into the middle ear. If the auscultation-tube is used during this procedure, the air will be heard to enter the middle ear with the same audible *click* observed when Valsalva's method of inflating the middle ear is employed.

During the act of swallowing the soft palate rises, thus cutting off all communication between the posterior nasal chamber and the mouth, and at the same time the Eustachian tubes are rendered more patulous by the action of the levator palati and other muscles, so that air forced into the nose by Politzer's method, having no other way of exit, readily finds its way into the middle ear through the tubes. The same thing may be accomplished with greater convenience by requesting the patient to "puff out his cheeks"

and compressing the air-bag while the mouth is thus inflated with air. Pronouncing certain syllables, like the words *hick*, *hack*, *hock*, also causes an elevation of the soft palate and a dilatation of the Eustachian tubes, so that the middle ear can readily be inflated by means of Politzer's air-bag. The middle ear of young children is usually more easily inflated by means of Politzer's air-bag than those of adults, while in the case of infants air readily enters the middle ear if Politzer's air-bag be used while the child is crying.

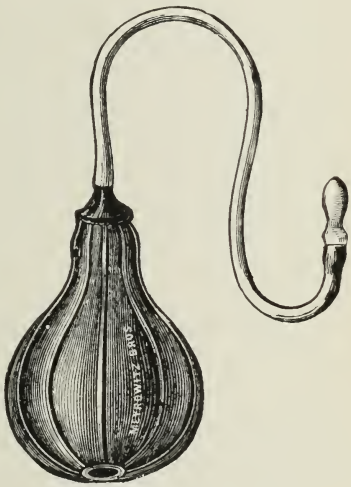


Fig. 187.—Politzer's air-bag.

No more force should ever be employed in compressing the rubber bag than is absolutely necessary to force air into the middle ear, and it is far better for the aurist to make several unsuccessful efforts to accomplish this purpose than to drive air into the middle ear with sufficient force to cause pain. While it is probably impossible to rupture a *normal* membrana tympani with Politzer's air-bag, yet several cases have been reported in which an atrophied or diseased drum-membrane has been ruptured by the incautious use of this instrument.

The *Eustachian catheter* is a tube of rubber or metal curved at its distal extremity, as shown in Fig. 188. The proximal end of the instrument is so constructed that the nozzle of Politzer's air-bag will fit *loosely* into it, and it is provided with a ring or mark of some sort by which the aurist is informed of the position of the beak of the instrument when it has been inserted in the nose. At least three sizes of this catheter should be in possession of the aurist—respectively 1, 2, and 3 millimeters in diameter. The hard-rubber catheters have the advantage of cheapness, but they are not so easily disinfected as are the metal ones,

which can be dropped into water and boiled or sterilized by pouring some alcohol over them and setting it on fire. Moreover, the hard-rubber instruments have a diameter larger in proportion to the size of their calibre than that of the silver catheters. The best catheters are made of pure or, as it sometimes is called, "virgin" (in contradistinction to "coin") silver, which insures a certain degree of flexibility. The cheap brass, nickel, or silver-plated instruments are clumsy, and are so hard, brittle, and inflexible that the curve of the beak cannot be slightly changed readily, as in the case of the softer pure silver instruments. The distal extremity should be slightly knobbed, smooth, and round. What is known as Hartmann's catheter is probably the best model (Fig. 188). It should be only sufficiently long to project about 1 inch from the anterior naris when the beak of the instrument is placed in the Eustachian tube-mouth.

FIG. 188.—Hartmann's silver Eustachian catheter.

In 1724, M. Guyot, a postmaster at Versailles, proposed to treat ear diseases by injections into the Eustachian tube by means of a catheter introduced through the mouth, "for the removal of obstructions in that canal and also the middle ear."

In 1741, Archibald Cleland, an English army surgeon, published an account of "instruments proposed to remedy some kinds of deafness proceeding from obstructions of the external and internal auditory passages." Cleland recommended "lubricating" the Eustachian tube by throwing a little warm water into its pharyngeal orifice through a flexible silver tube introduced through the nose into the Eustachian tube. The proximal end of Cleland's catheter had affixed to it a sheep's ureter, "whereby warm water may be injected, or they will admit to blow into the Eustachian tube and so force the air into the barrel of the ear and dilate the tube sufficiently for the discharge of the excrementitious matter that may be lodged there."

Cleland also used probes or bougies to explore the Eustachian tube through the nose. The use of bougies through the Eustachian catheter soon became quite popular and was shamefully abused, according to Wilde, who practically abandoned their use by contenting himself with introducing into the Eustachian tube for a short distance only a decalcified bone bougie, the end of which was made flexible by boiling water. His contemporary, Kramer, a distinguished Berlin aurist, used catgut bougies, which he stated he pushed along the tube in certain cases until the tip was visible between the handle of the malleus and incus.

Introduction of the Beak of the Catheter into the Eustachian Tube.—The operator should first inspect the anterior narium and note the position, size, and shape of any obstruction, such as a septal exostosis, which will interfere with the passage of the catheter. The operator should hold the proximal extremity of the catheter between the thumb and fingers of his right hand, somewhat in the manner of a penholder, and lift up the tip of the patient's nose with the thumb of his left hand. The beak or distal extremity of the catheter is then inserted within the nares and is made to rest upon the floor of the nose, while the proximal end of the instrument is elevated until it is parallel with the floor of the nose. Still keeping the beak of the instrument in contact with the floor of the nose, the catheter is pushed gently inward until the beak of the instrument is felt to be in contact with the posterior wall of the pharynx. At this stage the operator has the choice of the three methods of procedure in common use.

Probably the one most frequently employed is that of Löwenburg, who directs that when the beak of the instrument is felt to be in contact with the pharyngeal wall the catheter should be rotated medianly through an angle of 45 degrees, and drawn forward until the beak of the instrument is felt to touch the posterior edge of the septum, when it is rotated outward through rather more than an angle of 90 degrees, and should then be in the mouth of the Eustachian tube. The operator may feel satisfied that this is the case if the beak of the catheter is found to be somewhat firmly fixed in the position it has assumed, so that it is impossible

to rotate the beak of the instrument upward or carry it backward or forward without exerting considerable force.

Gruber directs that when the beak of the catheter is felt to be in contact with the pharyngeal wall it should be withdrawn until its curved portion comes into contact with the posterior margin of the hard palate. It should then be again pushed inward a distance of about $\frac{1}{2}$ inch, and rotated outward toward the ear through an angle of a little more than 45 degrees, when, if these maneuvers have been successful, the beak of the instrument will be within the mouth of the Eustachian tube.

When the beak of the instrument is felt to be in contact with the pharyngeal wall it may be immediately rotated outward 45 degrees, which will carry the beak of the instrument into Rosenmüller's fossa. The catheter should now be drawn gently outward until its beak is felt to slip over the posterior lip and into the mouth of the tube. An operator soon learns by the sensation imparted to his hand whether the beak of the instrument is or is not in the Eustachian tube.

Obstacles to Catheterization of the Eustachian Tubes.— Deviation of the septum may render the passage of a Eustachian catheter through that side of the nose impossible. Under such circumstances both Eustachian tubes may be catheterized through the unoccluded nostril. To reach the tube of the opposite side it will be necessary to have the beak of the catheter somewhat longer than that of the instrument shown in Fig. 188.

Ecchondroses or exostoses of the septum frequently interfere with the easy passage of the catheter through the inferior meatus of the nose. Under such circumstances the beak of the catheter can sometimes be passed over them and made to rest upon the floor of the nose or the soft palate behind. In some such instances a soft-rubber catheter can be used to advantage. In passing the catheter through the nose the instrument should be held very lightly between the thumb and finger, and a tendency to rotate on its long axis should not be resisted, because by allowing the instrument to rotate its beak will sometimes glide around an obstruction and finally find its way into the pharynx.

Another obstacle to catheterization of the Eustachian tubes results from spasmodic contraction of the muscles of the palate and pharynx, which tightly grasp the beak of the instrument and interfere with its proper manipulation. Gentleness and patience on the part of the surgeon will generally overcome this difficulty. The patient should be requested to inhale deeply through his nose, to "swallow," or say "One," and thus produce a temporary relaxation of the parts, which, if repeated from time to time, will generally enable the surgeon to guide the beak of the catheter into the mouth of the Eustachian tube.

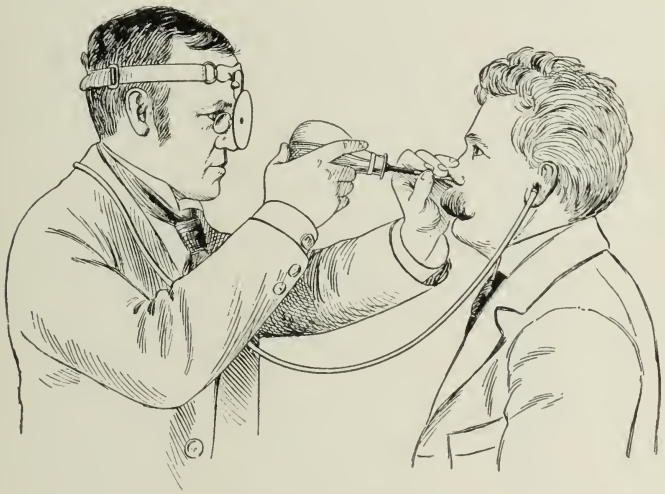


FIG. 189.—Auscultation of the ear.

When the beak of the catheter is felt to be within the mouth of the Eustachian tube it should be held in position with the thumb and forefinger of the left hand and steadied by two fingers resting upon the patient's face (Fig. 189). The nozzle of the air-bag is then fitted *loosely* into the proximal end of the catheter and compressed with the right hand. If the *auscultation-tube* be employed at the same time, air will be heard to enter the patient's middle ear with a sound somewhat similar to that produced by inflating the

middle ear by Valsalva's or Politzer's method. However, when the catheter is employed the sound seems as if produced *nearer* the surgeon's ear.

The *inflation of the middle ear* by means of the Eustachian catheter is not altogether devoid of risk. Deaths have been reported. The fatal results in these instances may have resulted from injection of air through a rent in the mucous membrane made by the beak of the catheter, which subsequently found its way beneath the mucous membrane to a position where the emphysema caused sufficient obstruction to respiration to occasion suffocation.

The writer saw 2 cases where young and inexperienced operators had injected a sufficient amount of the air contained in a Politzer bag through a Eustachian catheter into the cellular tissue to cause decided swelling of the tissues of the neck. In these 2 cases the patients simply suffered a certain amount of discomfort for a few hours, the air in the tissues being finally absorbed.

Solutions may be sprayed through the catheter by means of an ordinary atomizer by inserting the nozzle of the atomizer into the catheter. Either the compressed-air apparatus or the hand-bulb may be used to produce the spray. Under ordinary circumstances the spray probably does not penetrate the tube further than the isthmus, except the patient be told to swallow, when the spray may be heard through the auscultation-tube to enter the tympanum, sounding not unlike drops of rain falling on a tin roof. When compressed air is used to produce the spray it should be employed gently and with due caution. The automatic cut-off should be manipulated in such a manner as to throw the spray gently and by successive puffs into the Eustachian-tube orifices. The drip of the solution that condenses in the catheter should, at the completion of the treatment, be blown into the Eustachian tube by means of Politzer's bag.

Instead of employing an atomizer, fluid may be inserted within the catheter by an ordinary glass medicine-dropper and thrown into the tube with Politzer's bag, or fluid may be syringed through the catheter into the Eustachian tube, and when the drum-head is perforated, through the Eustachian tube and tympanum into the external auditory canal.

For this purpose syringe *a*, Fig. 38, with nozzle 7, fitted into an ordinary Eustachian catheter, answers the purpose, or the apparatus of Clevenger (Fig. 190) may be employed.

When the drum-head is intact fluid enters a narrow Eustachian tube beyond the isthmus only with great difficulty, having to compress before it the air contained in the middle ear. As soon as the pressure is relaxed the spring or rebound of the compressed air generally throws into the pharynx fluid contained in the tube. However, during the act of swallowing fluid may be made to penetrate into the cavity of the tympanum through the Eustachian tube even when the drum-head is intact, the muscular action in opening and shutting the tube during swallowing doubtless playing an important rôle under such circumstances. In this manner sea-water or fresh water introduced into the pharynx while bathing sometimes reaches the tympanum and almost invariably produces an acute otitis media. The writer has observed the same thing occur during the use of the Birmingham douche or even from sniffing normal salt solution into the nose from the hollow of the hand.

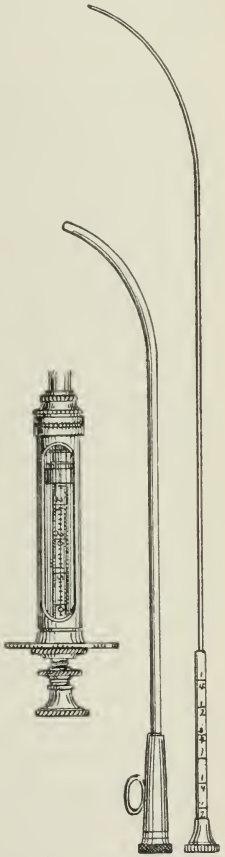


FIG. 190.—Clevenger's instrument for direct medication of Eustachian tube.

The introduction of watery solutions, even of the blandest character, is therefore not devoid of risk unless the drum-head is lacking or contains a large perforation. Bland oily fluids, on the other hand, can be sprayed or syringed into the middle ear with impunity. When a watery fluid is used to wash out the Eustachian tube the operator should be careful to inflate the middle ear several times by means of Politzer's method in order

to remove any excess of fluid that might otherwise remain.

Solutions of protargol, 10 to 50 per cent., nitrate of silver, $\frac{1}{2}$ to 1 per cent., potassium iodid, 1 per cent. (in syphilis), may safely be introduced into the mouth of the Eustachian tube.

An *Allen's probe* (Fig. 35), sufficiently long to extend $\frac{1}{4}$ inch beyond the catheter mouth, may be used as an applicator by wrapping a few fibers of cotton about its tip and dipping the end of the probe into the solution to be used. After the beak of the catheter is in position the cotton-tipped probe is passed through it and an application of the remedy made to the first $\frac{1}{4}$ inch of the Eustachian tube, or the end of a cotton-tipped Allen's probe, after being dipped into any appropriate solution, may be passed like a catheter through the nose into the nasopharynx and the cotton-tipped end inserted into the mouth of the Eustachian tube.

Eustachian bougies are occasionally used for the dilation of strictures of the Eustachian tube and other purposes. They are filiform in character and a number of sizes are obtainable, made of whalebone, hard rubber, celluloid, or gold, for electrolysis of stricture. They are inserted into the Eustachian tube through a catheter. Great gentleness should be used in passing a Eustachian bougie for the first time through an inflamed tube, for it is easy to penetrate tissue with so small an instrument and make a false passage. The length of the catheter employed should be marked upon the bougie and also the length of the Eustachian tube, which is about $1\frac{1}{2}$ inches; and this last mark cannot be passed without danger of injury to the tympanic contents or penetrating the drum-head.

Not much force is necessary to pass a Eustachian bougie through a normal tube. When a stricture is encountered gentle pressure will usually finally overcome the obstruction, after which the bougie passes readily onward. The most frequent position of stricture is at the isthmus.

Before attempting to pass the bougie a few drops of albolene should be inserted in the catheter and blown into the Eustachian tube by means of Politzer's bag. If a stricture is passed the bougie should be allowed to remain

in position for five or ten minutes. After the bougie is withdrawn the middle ear should be gently and cautiously inflated. If there be reason to suppose that during the passage of the bougie the mucous membrane has been torn, it will be safer to dispense with inflation, lest air penetrate the cellular tissue.

Electrolysis of Eustachian strictures has been done by Duel by means of an insulated Eustachian catheter and gold bougies, of which he has designed three sizes. The amount of current necessary to overcome an obstruction and promote absorption of a stricture is 3 to 5 milliampères, which should be turned on as soon as an obstruction is felt and continued for not longer than three to five minutes. The negative pole of the battery is attached to the bougie, the positive held in the patient's hand or applied to the nape of his neck. There is little pain produced by the procedure, which may be repeated at intervals of a week. Inflation should not be practised immediately after the use of the electric bougie, but the patient may return the next day to have his middle ear inflated.

DISEASES OF THE EXTERNAL EAR

Congenital Defects.—The auricle may be wanting entirely or there may be a plurality of auricles (Fig. 191). The auricle may be abnormal as regards position or shape or it may only be partially developed. Malformations of the auricle are generally associated with defects or absence of the external auditory canal (Fig. 192) and sometimes imperfect development of the deeper portions of the auditory apparatus. A congenital fistula is sometimes seen about the external ear and may communicate with the tympanic cavity (Fig. 193). Excessive development or lack of development of the external ear is due to excessive or imperfect development in the closure of the first branchial cleft during embryonic life. Various operations have been devised to correct deformities of the auricle and open a way down to the tympanum in cases of stenosis of the external auditory canal. Plastic operations in this locality do well as regards the healing process. Operations for the correction of atresia or

stenosis of the external auditory canal hitherto have not been successful.

Othematoma or **perichondritis** of the auricle (Fig. 194) is generally the result of direct violence—self-inflicted in the

FIG. 191.—Supernumerary auricle in the neck (*Lancet*, 1888).

insane, among whom the disease is not uncommon. This affection is characterized by an effusion beneath the perichondrium of the auricle, causing swelling, tension, and pain

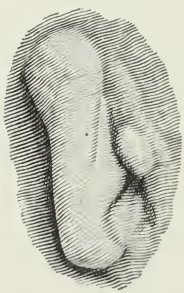


FIG. 192.—Congenital deformity of the auricle (Sexton).

FIG. 193.—Convoluted auricle with congenital fistula (Sexton).

in the part. The effusion may finally escape through an external opening which it has made for itself, remain as a swelling for an indefinite time, or slowly be absorbed. Even

when reabsorption of the effusion does occur, considerable deformity of the auricle may result (Fig. 195).

Treatment.—In the insane, hematoma of the auricle is best let alone, unless the local inflammation is sufficiently great to indicate that infection has occurred and that the effusion has become purulent. If necessary inflammation should be combated by the application of ichthyol ointment, 20 per cent. in lanolin (adeps lanæ hydrosus), and progressive effusion by painting the affected

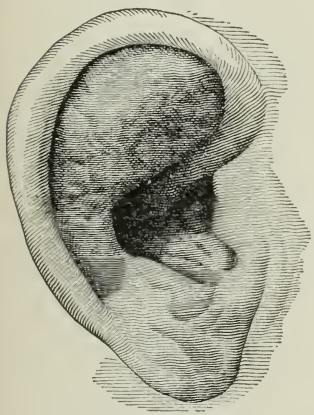


Fig. 194.—Medium-sized othematoma of the auricle (Sexton).

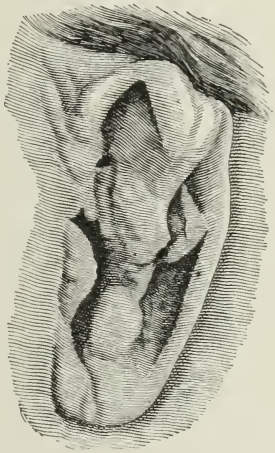


Fig. 195.—Deformity of the auricle due to othematoma (Sexton).

parts with contractile collodion and the use of a pressure bandage. Absorbent cotton is placed between the auricle and the head and a pad of cotton over the auricle, and pressure maintained by means of a roller bandage over the auricle and around the head. The bandage should not be applied with sufficient firmness to cause pain or great discomfort. If, notwithstanding these measures, the collection of fluid beneath the perichondrium increases, the parts should be aspirated with antiseptic precautions—a measure that will probably need repetition from time to time. In cases where the inflammation is great and the effusion beneath the periosteum is evidently purulent, it is best to lay

the parts freely open, wash out the pus-cavity with sublimate solution, and pack with iodoform gauze. The incision should be sufficiently free to permit of easy dressing and the ready removal of sloughing cartilage as soon as separated from the living tissue. Fortunately the number of cases where the injury to the auricle is sufficently severe to cause sloughing of even a small portion of the cartilage are comparatively few.

Chronic perichondritis is a chronic inflammation of the cartilage of the auricle observed in boxers and others whose ears are constantly subjected to irritation or slight traumatism.

Treatment consists in gentle massage and applications of ichthyol ointment (20 per cent.) at bedtime, with the avoidance of the cause of the irritation.

Incised and **punctured wounds** after thorough cleansing should be sutured in such a manner as to leave as little scar as possible upon the lateral surface of the auricle. In contused and lacerated wounds perichondritis almost invariably occurs, and it is well to anticipate such an attack by the application of a wet bichlorid dressing for twelve to twenty-four hours. An attempt should be made to save as much tissue as possible and no part which possibly may have sufficient vitality to live should be removed. As a primary measure but few sutures should be used, as after the circulation has been thoroughly established it is ordinarily a simple matter to secure more perfect coaptation of the parts and prevent deformity. The sutures should not be passed through the cartilage unless absolutely necessary, although no great harm usually results from a suture through the cartilage of the auricle.

Fracture of the base of the skull involving the temporal bone may extend into the auditory canal in some cases without rupture of the membrana tympani. Hemorrhage from the ear may be somewhat profuse or scanty. In addition to the general treatment the ear should be thoroughly cleansed of clots by gentle syringing with a warm bichlorid solution (1 : 1000), dried, and covered with powdered boric acid, except where oozing persists, when the auditory canal should be *very lightly* packed with sterile

iodoform gauze. The ear should be gently cleansed once a day with the bichlorid solution and packed with gauze as long as oozing persists; after which the parts are best kept as dry as possible by cleansing when necessary with bichlorid solution, thoroughly drying the parts, and insufflating powdered boric acid. A light plug of iodoform gauze may be loosely inserted into the concha for a few days. Boric acid in sufficient quantity to cover the wound is apparently sufficient to prevent infection. Packing the canal maintains a warm and moist condition of the wound that should be avoided.

Cleft lobule, which is generally the result of the tearing out of an earring, is common and may be remedied by the following operation: The sides of the cleft are freshened in the same manner as for a hare-lip operation; but, to avoid as far as possible the formation of a conspicuous scar, the sutures should be introduced and tied on the inner side of the lobule, and should involve only the deeper layers of the skin of its outer surface. After the parts have been accurately adjusted and the sutures tied, the wound should receive further support by the application of iodoform collodion. If the operation be done under antiseptic precautions it is generally successful.

Keloid of the auricle, originating in the scar resulting from piercing the ear for earrings, is not uncommon, especially in the negro. The growth consists of a hard nodule of fibrous tissue, generally tender on pressure. If large it should be removed by the knife. There is a tendency for the growth to recur. Encouraging results have been reported from the application of the *x*-ray in cases where the growth has recurred after removal by the knife.

CUTANEOUS DISEASES OF THE AURICLE

The cutaneous diseases which sometimes attack the auricle are hyperemia, frost-bite, burns, eczema, dermatitis, comedo, erysipelas, syphiloderma, herpes, lupus, and impetigo contagiosa.

Hyperemia may be either active or passive, transient or chronic in character. There is an increase in the blood

supply of the auricle and generally of the canal, so that the skin appears redder than normal and feels hot to the patient. Mild cases are due to some transient vasomotor disturbance that usually soon passes away without treatment. In some individuals a single comparatively small dose of quinin, salicylic acid, or chlorid of calcium will produce hyperemia of the auricle and canal that may persist for some time.

Active hyperemia of the auricle may result from exposure to cold, sunburn, or other irritants. Passive hyperemia of the auricle and canal are sometimes present as the result of gout, valvular disease of the heart, or any organic disease capable of producing localized blood stasis.

Treatment.—The best local application is probably liquor plumbi subacetatis, which may be painted on the parts once or twice a day. Nervous cases will need building up; the gouty, a correction of the constitutional dyscrasia.

Dermatitis is an inflammation of the skin generally resulting from some injury, such as the bite of an insect, a blow, fall, stab, wound, etc.

The *symptoms* vary from slight inflammation of the skin at the point of injury to localized gangrene.

Treatment.—This varies with the severity of the inflammation and the character of the infection. Mild cases do well by simply painting with liquor plumbi acetatis. The severer cases require a wet dressing of bichlorid of mercury, as in infected wounds of other parts of the body. The dermatitis following the sting of insects is treated by a wet dressing of 20 per cent. bicarbonate of sodium.

Frost-bite.—In cold climates frost-bite of the auricle is by no means uncommon. At first the auricle is cold and numb and sometimes stiff, as if actually frozen solid. Later on the symptoms are those of traumatism, involving only the skin or the skin and deeper structures. The skin is hot and swollen, frequently excoriated or covered by vesicles. In the severer cases the symptoms are those of perichondritis, followed sometimes by cartilaginous necrosis and the formation of sinuses upon either surface of the auricle.

Treatment.—When the auricle is frozen its temperature

should be restored gradually by gentle friction with snow or pounded ice, and afterward by gentle manipulation with the fingers. If only the skin is involved by the subsequent inflammation satisfactory results will follow the application of a 10 per cent. ichthyol ointment in vaselin, which should be applied sufficiently often to keep the parts constantly covered and protected by the ointment. In some cases pain and soreness are greatly relieved by wrapping the auricle in absorbent cotton after using the ointment and applying gentle pressure by means of a bandage. When perichondritis follows frost-bite of the auricle it should be treated in the manner already described. When sinuses have formed, they should be laid open, the necrosed tissues removed, and the wounds allowed to heal by granulation. If care is taken to keep the parts properly supported but little deformity sometimes results.

Burns.—The auricle is liable to burns, sometimes severe, and involving not only the surrounding neck and scalp but also the auditory canal. A common cause of slight burn of the auricle sufficient to raise a blister is hot applications for the relief of the pain of otitis media.

Treatment.—Pain is best relieved by the local use of cold, applied either in the form of an ice-bag or napkins wrung out of ice-water. The application of cold should be continued as long as it affords relief.

Charred and dead tissue, if the burn is a severe one, should be at once removed, and the parts cleansed from soot and dirt by means of copious washings with a solution of bicarbonate of sodium. The parts are then dusted with orthoform or smeared with a 3 per cent. carbolized petroleum, a bandage applied, and over this an ice-bag is placed as long as the cold seems necessary for the relief of pain. Excessive pain not quickly relieved by these measures will require a hypodermic of morphin.

When the skin is unbroken the best dressing is the so-called carron oil (equal parts of linseed oil and lime-water). This is smeared thickly on patent lint and applied to parts after they have been cleansed with bicarbonate of sodium solution.

Herpes.—Herpes of the auricle is similar to the disease

when it occurs upon the skin in other localities. It is characterized by vesicles filled with a clear serum, appearing singly or in groups, upon the helix or about the lobule. The surrounding skin is reddened, slightly swollen, and tender to the touch. There may be slight fever, pain, and itching of the auricle. The affection is due to some nervous disturbance. The vesicles ordinarily dry up and disappear by the end of ten days or two weeks.

Treatment.—The milder cases are best treated by gentle purgation with citrate of magnesia or one of the other salines. The vesicles should be painted three or four times a day with camphorated tincture of opium (paregoric). This application seems to allay the slight itching and burning better than most others and hastens absorption. Should the contents of the vesicles become purulent the vesicles should be opened and the parts washed with bichlorid solution and dusted with powdered calomel.

Impetigo contagiosa is an acute contagious disease of the skin sometimes encountered upon the skin of the auricle or nose in dispensary practice. It begins as small discrete or confluent vesicles, which rupture and leave a granular surface resembling closely a vaccination sore. It is contagious, but no characteristic organism has as yet been isolated. Recovery usually occurs within a week under antiseptic treatment.

Treatment consists in keeping the parts clean by washing with bichlorid solution and applying either powdered calomel or an ointment of ammoniated mercury.

Lupus vulgaris is a chronic tuberculosis of the skin of the auricle, either primary or extending to the auricle from the skin of the face. The disease begins as a tubercle deep in the skin. The dull reddish tubercles are sometimes years in developing, but finally break down into a characteristic ulceration which may heal at one extremity while it is spreading in another direction. The disease is exceedingly chronic and years may go before a large portion of the auricle is involved. After healing has occurred the auricle is shriveled, shrunken, and deformed.

Diagnosis.—The diagnosis is usually made by the appearance of the ulcer and the history of extreme chronicity.

The disease might be mistaken for either syphilis or epithelioma, but each is much more rapid in its course.

Treatment.—The internal medication consists in the administration of cod-liver oil and arsenic. The local treatment consists in a thorough cureting of the ulceration and the application of the solid stick of nitrate of silver. This should be followed by cautious applications of the *x*-ray for ten minutes every other day.

Syphilis.—*Primary syphilis* of the auricle is naturally rare, but the auricle may become inoculated by a bite or other cause. Chancre of the auricle differs in nowise from the primary lesion elsewhere upon the skin. It is an ulcer with indurated edges and a hard base generally conforming to the papular type. The lymphatics of the neck are swollen.

Secondary syphilis of the auricle is generally part of a syphiloderm involving more or less of the whole body.

Tertiary syphilis of the auricle consists of a gumma either before or during the stage of ulceration.

Diagnosis of the primary lesion is sometimes difficult unless there is the history of a bite or injury by a syphilitic individual. The diagnosis in the secondary stage is usually easy. In the *tertiary stage*, however, an ulcerating gumma may be mistaken for either lupus or epithelioma, and it will usually be necessary to administer iodid of potassium in increasing doses before coming to a definite conclusion.

Treatment.—The constitutional treatment differs in nowise from that of syphilis of the nose, pharynx, or larynx already described.

Congenital syphilis is usually of the tertiary variety. Its treatment differs in no respect from the acquired disease. The writer remembers only 1 case observed by him, that of an infant about eight months old, with an ulcerating gumma of the meatus. The external orifice of the meatus was nearly occluded by exuberant granulations, which were snared away and the parts kept clean and dusted with calomel powder. The internal treatment consisted of gray powder and inunctions of mercury. The infant made a good recovery.

Erysipelas is the result of infection of the skin with the

streptococcus erysipelatosa of Fehleisen. It is presumed to only invade the skin through some traumatism, possibly so minute as to be overlooked. The writer saw in consultation 2 cases that had their origin in a blister produced by painting the mastoid process with cantharidal collodion. In both these cases, occurring in old men, the erysipelas extended to the scalp; in one with a fatal result. Erysipelas of the auricle may extend along the canal and involve the drum-head.

Symptoms are those of erysipelas in other localities. The disease is usually ushered in by a chill and high temperature. There is headache and anorexia. The infected area is red and swollen and the swelling and redness somewhat rapidly spreads until sometimes the entire auricle is involved and the disease has attacked adjacent skin areas. Vesicles filled with serum may or may not appear.

Treatment.—The patient, if in a hospital, should be isolated from other surgical cases. It is well to begin treatment with a calomel purge ($\frac{1}{5}$ gr. every hour until $1\frac{1}{2}$ gr. have been taken), followed by a bottle of the solution of citrate of magnesia. As soon as the bowels have acted freely the patient should take 20 drops of the tincture of the chlorid of iron every two or three hours and $\frac{1}{30}$ gr. of strychnin every four hours. It is said that some cases can be aborted by painting the infected and adjacent skin area with carbolic acid, which is allowed to remain until it has blanched the skin surface. The excess of acid is then washed off with alcohol. Most of the writer's cases have been treated locally by applications of 20 per cent. ichthyol in lanolin, which was smeared thickly on patent lint and applied to the parts. The treatment is effective, but somewhat dirty. Those cases of facial erysipelas seen in the Philadelphia Hospital during his terms of service there were treated locally by applications of patent lint kept moist with a 10 per cent. solution of protargol. Apparently one treatment was about as effective in controlling the local symptoms as the other.

Phlegmonous erysipelas is a severe form of erysipelas involving the deeper structures beneath the skin with the formation of abscesses. It is generally the result of mixed

infection, the streptococcus erysipelatosa and the streptococcus or staphylococcus pyogenes being found in the discharges.

The *symptoms* are those of severe erysipelas—high fever, redness, pain, and great swelling of the auricle, with formation of pus and exfoliation of cartilage.

Treatment.—The auricle should be covered with a dressing kept constantly wet with bichlorid solution (1 : 1000). As soon as the presence of pus is suspected the parts should be freely incised down to the cartilage. The wound should be syringed daily with a bichlorid solution and, if necessary, packed with gauze in such a manner as to secure perfect drainage.

Gangrene is, in modern times, an extremely rare disease, but is said to occur occasionally either in the moist or dry form.

Treatment.—This is similar to that of phlegmonous erysipelas. Iron and strychnin should be given internally. The parts should be kept covered with a wet bichlorid dressing and every effort made to secure asepsis. Necrotic tissue should be removed as soon as possible. Localized pain can be controlled by dusting with iodoform and, when this is ineffective, with orthoform.

The disease is very contagious, at least to other surgical cases. Therefore the patient should be carefully quarantined and all dressings, towels, etc., used about the case destroyed.

Eczema is by far the commonest of the skin diseases affecting the auricle. It may also involve the auditory canal and even the dermoid layer of the membrana tympani. Intertrigo resulting from the invasion by the disease of the fissure formed by the junction of the auricle with the mastoid region is of frequent occurrence in infants and young children.

Treatment.—In adults the disease is sometimes the result of the rheumatic or gouty diathesis, and, in addition to local treatment, such cases require the administration of alkalies, with iodid of potassium, salicylate of sodium, or arsenic. In children the disease is frequently associated with struma, and for such cases cod-liver oil or syrup of

the iodid of iron should be prescribed. Eczema intertrigo is best treated by the frequent application of powders, and oxid of zinc or subnitrate of bismuth may be prescribed for this purpose.

The commonest *cause* of eczema of the auricle in children is an irritating discharge from the middle ear. In the neglected infants of the poor the discharges resulting from purulent inflammation of the tympanum are frequently smeared by the fingers of the child over the entire auricle and over the skin in front of and behind the ear. Under

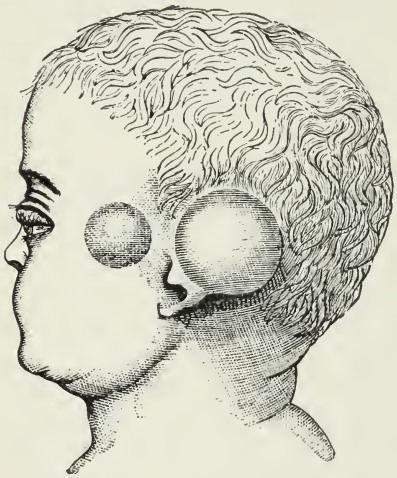


FIG. 196.—Dermoid of the auricle and nevus of the palpebral conjunctiva (after Lannelongue).

FIG. 197.—Cartilaginous tumor in front of the left ear of a newborn infant (Fruhwald).

such circumstances the auricle and surrounding skin become covered by eczematous scabs and crusts. These the surgeon should carefully remove by means of pledgets of cotton saturated with peroxid of hydrogen, and rub well into the affected parts an ointment consisting of 6 or 8 gr. of the yellow oxid of mercury to 1 ounce of petrolatum. A single thorough application of this remedy is sometimes sufficient to bring about great improvement, even in cases in which the disease has existed for several months. Perfect cleanliness in all cases should be enjoined, and if fre-

quent cleansing of the auditory canal with absorbent cotton, followed by insufflations of powdered boric acid, is not sufficient to keep the concha dry and free from the discharge, the skin of this part of the ear should be protected by some bland ointment. Benzoated zinc ointment, if *fresh* and properly made, answers very well for this purpose.

The **new growths** that occur on the auricle are sebaceous cyst, fibroid tumor, epithelioma, nevus, sarcoma, and cornu cutaneum.

The *treatment* is the same as if the new growths occurred elsewhere. Nevi in suitable cases should be treated by electrolysis. The other growths ordinarily require excision.

DISEASES OF THE EXTERNAL AUDITORY CANAL

The more common affections of the external auditory canal are acute circumscribed inflammation or furunculosis, acute and chronic diffuse inflammation, diphtheritic inflammation, hyperostosis, exostosis, and foreign bodies.

Furuncle or Acute Circumscribed Inflammation.—Recurrent attacks of furunculosis of the auditory canal seem, in many instances, to be the result of irritation from carious teeth or from disease of the interior of the nose and throat. The affection is commonest in gouty or anemic and debilitated individuals and in women suffering from menstrual disorders.

Pathology.—In most instances the starting-point of the disease is a sebaceous gland or a ceruminous follicle, which has become inoculated with the staphylococcus pyogenes aureus or other pus-forming bacteria by scratching the ear with a dirty finger-nail, hairpin, match-stick, etc. Metastatic abscess in the canal is said to sometimes occur in gonorrhea. The inflammation usually soon becomes a circumscribed perichondritis or periostitis of the auditory canal. The pathology of acute circumscribed inflammation of the external auditory canal is similar to that of boils and felons occurring elsewhere on the body.

Symptoms.—There is at first an itching within the canal, a portion of which is found tender to the touch, and soon becomes painful. Little by little the pain and tenderness increase, until in some instances the patient's sufferings

become almost unendurable. In severe cases the pain, which at first was confined to the ear, extends to the whole side of the head, is throbbing in character, and is increased by movements of the jaw in talking, eating, etc. There is some elevation of temperature in the severest cases. Deafness is not a marked symptom until the swelling is large enough to close the canal at the part involved, but tinnitus is present in the majority of cases. The furuncle will rupture spontaneously in from two to eight days, according as the inflammation is superficial or deep seated. The discharge is purulent, sometimes quite profuse; and its appearance is speedily followed by a subsidence of acute pain; the parts, however, remain sore for several days. A "core" or small slough of the skin, as in boils elsewhere, usually exfoliates before the parts heal.

Treatment.—Speedy relief generally follows a free incision through the swollen parts down to the cartilage or bone, even though no pus be found. The incision should be followed by syringing the canal with hot boric acid solution, the insertion into the canal of a cone of absorbent cotton covered with a 10 per cent. ointment of cocain in lanolin, and the application of heat.

In cases where incision is not advisable a cone of cotton should be well covered with an ointment of the yellow oxid of mercury (6 gr. to 1 ounce of vaselin), and so placed within the canal that it will exert pressure upon the swollen parts. For a few moments this procedure increases the pain somewhat, but it is followed by a feeling of decided relief and comfort. The ointment is rubbed into the skin of the canal by each movement of the jaw in talking and eating, and if the treatment is applied early enough many cases of furunculosis of the auditory canal may be aborted before suppuration has occurred. Cotton cones are readily made by selecting a piece of absorbent cotton about 2 inches long and about $\frac{3}{4}$ inch wide. The two ends of the piece of cotton are then frayed out until the center of the cotton is thicker than the edges. The cotton is then folded through its central thick portion, so that the thin edges are brought together and a wedge is thus formed, one edge being very thick and the other thin. This wedge is now

wrapped somewhat firmly about the end of an Allen's ear probe (Fig. 199), the thick edge of the cotton wedge toward the handle of the instrument in such a manner that the thin edge of the cotton wedge forms the pointed end of the cone. The cone thus made should be firmly enough wrapped about the probe to be smooth and taper evenly

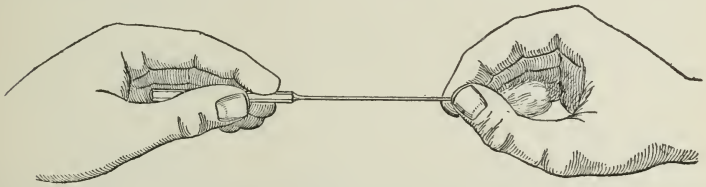


FIG. 198.—Method of wrapping cotton about the end of an Allen's probe to form a brush for cleansing the canal, applying pigments, etc.

from apex to base. When made it is coated thickly with the appropriate ointment and inserted gently into the canal until its wedge-like pressure begins to cause pain. The probe is then dislodged from the cone by turning it in the opposite direction to that in which the cotton was wrapped about it and steadying the cone with a touch of the left

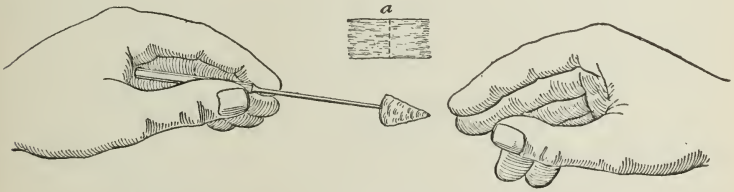


FIG. 199.—Method of wrapping cotton about the end of an Allen's probe so as to form a cone for applying pressure within the auditory canal. A piece of absorbent cotton is frayed out to thin edges, folded through the center (dotted line *a*), and wrapped about the end of the probe.

forefinger so that the cone is not withdrawn from the canal with the probe. If after a few moments the pressure of the cone instead of affording relief causes increased pain, the patient can withdraw it slightly and after an interval again push it more deeply into the canal.

Some relief from pain follows the application of a 10 per cent. ointment of cocain in lanolin or a 1 per cent. ointment

of atropin. Heat, however, generally gives speedy relief from pain. It may be applied by gently syringing the canal with hot water, by the application of a poultice, or by resting the head upon a hot-water bag or a bag of hot salt or of hops. In severe cases it is advisable to secure a free evacuation of the bowels by means of small, frequently repeated doses of calomel and bicarbonate of sodium; 1-drop doses of tincture of aconite-root, repeated every hour, will control to a certain extent fever and pain. In all cases the cause of the attack should carefully be sought and measures adopted to prevent a recurrence. To prevent inoculation of other parts of the canal and producing a so-called crop of boils, the canal should be carefully cleansed either by syringing gently each day with a warm 1 : 1000 bichlorid solution or by simply wiping out the pus with absorbent cotton and afterward sterilizing the skin of the canal by painting it with nitrate of silver solution (ʒj to f℥j of water).

Otitis Externa Diffusa Acuta.—Diffuse inflammation of the auditory canal varies in character from a simple erythema of the skin of the auditory canal to severe periostitis. The disease usually attacks the osseous portion of the canal, but it may extend to the auricle, and, by periosteal continuity, to the periauricular and mastoid regions, causing abscess and necrosis.

Etiology.—The disease usually occurs in persons whose general health is impaired. It is sometimes consecutive to an attack of otitis media acuta or it may be caused by an irritating discharge from the middle ear. The affection, which usually begins in the skin or cellular tissue, may extend to the periosteum and bone.

Symptoms.—The symptoms are similar to those of furuncle of the auditory canal, except that the pain is usually more intense and appears at an earlier stage of the disease, while deafness and tinnitus are more marked and long continued. On inspection the tissues of the auditory canal appear red and swollen. The swelling is usually greatest in the bony portion of the canal, where it may be so great as to completely obliterate the canal and prevent a view of the drum-head from being obtained. Generally the skin is

excoriated at points where the inflammation is greatest, and usually there is desquamation and a slight watery discharge.

Treatment.—Incision of the swollen tissues is rarely necessary unless an abscess has formed. Pain can generally be alleviated very much, if the case is seen early, by the application of a large leech to the skin in front of the tip of the mastoid, as closely as possible beneath the auditory canal. A leech also may be applied in front of the tragus and one on the mastoid, as close to the canal as possible.

In many cases it will be necessary to prescribe morphin to completely control the pain and secure sleep; but *heat*, applied in the manner already described, will be all that is necessary in the majority of instances. The canal should be cleansed and carefully dried with absorbent cotton and the parts painted with a 60-gr. solution of nitrate of silver and dusted with powdered calomel. This should be done every day as long as the symptoms are acute, and afterward, as the disease subsides, at longer intervals. In using an insoluble powder like calomel within the canal care should be exercised not to more than lightly cover the skin and not employ a quantity sufficient to form a hard crust, which by its pressure will cause pain.

Otitis externa diffusa chronica occurs in individuals whose health is impaired, or it may be the result of the gouty or rheumatic diathesis, or the irritation caused by carious teeth, or disease of the nose and throat. The growth of Aspergillus within the inflamed canal may be a complication or a cause of disease.

Symptoms.—Patients complain of itching and a sense of heat within the canal. Pain is usually absent, except during acute exacerbations. Upon inspection the skin of the auditory canal is found to be red and swollen, especially in the deeper portions. The inflammation may be of the eczematous or desquamative type and accompanied by a watery discharge or seborrhea.

Treatment.—The cause of the affection should be carefully sought. Patients of the strumous diathesis or in feeble health will require the administration of cod-liver oil and

tonics, and appropriate remedies should be prescribed for those in whom the disease seems to be the result of the rheumatic or gouty diathesis. If carious teeth are present they should receive the attention of a skilful dentist, and any disease of the nose or throat that may be present should be properly treated. The local treatment of chronic diffuse inflammation of the external auditory canal varies according to the stage and variety of the disease present. When the disease is of the eczematous type, all scales and scabs should be removed by means of a pledget of absorbent cotton wrapped about a probe and dipped into a solution of the peroxid of hydrogen and yellow oxid of mercury

FIG. 200.—A, Aspergillus glaucus; B, Aspergillus niger; C, ripe fructiferous head of Aspergillus niger throwing off spores (Burnett).

ointment (Formula 41), well rubbed into the parts. When there is considerable secretion of watery fluid the canal should be dried thoroughly and brushed with a solution of nitrate of silver (60 gr. to 1 ounce of water) and covered with powdered calomel.

Mycosis or **otomycosis** is an inflammation of the external auditory canal due to the presence of a fungus. Aspergillus glaucus (Fig. 200, A) and Aspergillus niger (Fig. 200, B, C) are the varieties most frequently met with. The presence of moulds in chronic inflammation of the external auditory canal may be the cause of the inflammation or only a complication of the disease.

The *symptoms* are those of an acute or chronic inflam-

mation of the canal, except that when there is a large mass of mould present filling the fundus of the canal the patient will be deaf from the accumulation. This is usually a pasty, whitish material interspersed with black spots, looking not unlike a wad of wet newspaper. The microscope will detect the presence of either or both the Aspergillus glaucus or niger or some other species of Aspergillus or Mucor.

Treatment.—When Aspergillus is present, the canal should be cleansed thoroughly each day with peroxid of hydrogen and an application made of a 60-gr. solution of nitrate of silver or of absolute alcohol. It is essential that the canal should at all times be kept absolutely dry, because nothing more favors the growth of Aspergillus than moisture. Discharges should be absorbed by the application of powdered boracic acid or a mixture of powdered boracic acid and aristol.

Otitis Externa Diphtheritica.—Diphtheritic inflammation of the integument of the external auditory canal is an inflammation characterized by the presence of a pseudomembrane, which when removed leaves a bleeding surface. The pseudomembrane should contain the Klebs-Löffler bacillus characteristic of true diphtheria, as other bacteria are capable of causing a pseudomembrane within the auditory canal and upon mucous surfaces.

Etiology.—The disease occurs usually as a complication of diphtheria of the throat and middle ear. Primary diphtheria of the walls of the external auditory canal has been observed during epidemics of diphtheria.

Symptoms.—In the primary form there are deafness and tinnitus, with pain. The meatus is greatly swollen. The lymphatics at the angle of the jaw are also swollen and tender to the touch. There is usually systemic depression and slight elevation of temperature. Examination discloses the pseudomembrane covering the swollen skin and bathed in discharges, so that the canal is nearly occluded, or, if the disease has occurred in a case where the drum-head has been previously destroyed, only the mucous membrane of the tympanum may be occupied by the diphtheritic membrane.

The secondary form of the disease sometimes causes destruction of the membrana tympani and the tympanic contents. Occasionally, as in scarlet fever, necrosis of portions of the temporal bone occurs.

Treatment.—The canal should be syringed with a warm bichlorid solution (1 : 1000). The pseudomembrane should then be removed with the forceps and peroxid of hydrogen. After the parts have been cleansed of membrane they are dried with absorbent cotton and painted with a 60-gr. solution of nitrate of silver in water and covered with a thick coating of boric acid.

Pepsin, trypsin, caroid, and other substances will dissolve the pseudomembrane, but their use is not desirable in the ear because the pseudomembrane soon ceases to re-form when the parts are constantly covered by antiseptics.

Otitis externa crouposa is an acute inflammation of the external auditory canal characterized by the presence of a pseudomembrane which does not contain the characteristic bacilli of diphtheria.

Diagnosis.—The membrane when removed commonly leaves a bleeding surface, as is the case with the pseudomembrane of diphtheria, because croupous membranes rarely if ever occur except upon a skin not already excoriated.

The bacteria are said to be those of a mixed infection, usually streptococcus and staphylococcus.

Symptoms.—The symptoms are practically those of diphtheria of the external auditory canal, except that the cervical glands are rarely as much swollen and inflamed. There is earache, tinnitus, and a greatly swollen meatus, with purulent discharge and, generally, slight fever.

Treatment is the same as in diphtheritic otitis. The pseudomembrane is removed with forceps and peroxid. After the parts are dried with absorbent cotton they should be thoroughly painted with a 60-gr. solution of nitrate of silver and covered with a thick coating of boric acid by means of a reservoir powder-blower. This treatment should be repeated once or twice a day. It is probable that after two or three applications the pseudomembrane will cease to appear, but daily treatment should be persisted in until the skin of the canal has assumed a normal appearance.

Exostosis and Hyperostosis (Osteomata).—The name "exostosis" was applied formerly to all bony outgrowths within the auditory canal. At the present time, however, the name is restricted to bony growths at the junction of the cartilaginous and bony portions. Exostoses of the meatus are usually single and pedunculated. Hyperostoses are situated at the inner end of the meatus close up to the membrane, are sessile, and generally multiple (Fig. 201). Both exostoses and hyperostoses are whitish prominences, firm and hard when touched with a probe.

Etiology.—Hyperostoses in most instances are probably congenital, and in all cases their presence and growth are painless, while an exostosis is always preceded by inflammation. A subperiosteal abscess forms over the mastoid, the pus finding its way into the meatus at the junction of the cartilaginous and bony portions of the canal. The mouth of the sinus in this position becomes occupied by exuberant granulations from the bone, which become converted into bone.

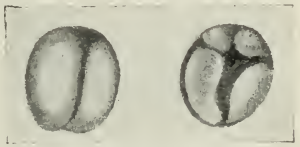


FIG. 201.—Exostoses and hyperostoses (Spalding).

Symptoms.—Hearing is not impaired unless the bony growth or growths are large enough to entirely block the lumen of the meatus. The smallest opening is sufficient to transmit sound-waves. If, however, such a small opening is occluded by a drop of fluid, or by a few scales of epithelium, or by a small mass of cerumen, the hearing at once is grealy impaired. When purulent disease of the middle ear is present the presence of hyperostoses will greatly interfere with drainage and render the disease difficult to cure.

Treatment.—If an exostosis is large and attached by a rather small pedicle to the auditory canal, especially if the growth be slightly movable, it can readily be detached by means of a small chisel and extracted with a pair of forceps. Exostoses of this character should always be removed.

Occasionally *sessile exostoses* are encountered that extend the whole length of the bony canal and encroach upon the position of the drum-head. Under such circumstances it is best to secure additional room for the necessary chiseling

by detaching the auricle and cartilaginous canal and pushing it forward out of the way in the same manner as in the radical mastoid operation. The bony canal should be enlarged by the removal of rather more bone than that comprising the exostosis, in order to provide for cicatricial contraction during the healing process. If the cartilaginous portion of the canal is contracted, it should be slit up and the parts adjusted in position in the same manner as after a radical mastoid or Stacke operation. The more superficial parts of the exostosis are very readily removed by a suitable gouge or chisel; but when the neighborhood of the drum-head is reached it is well to employ a dental burr if the bone is found to lie closely in contact with the drum-head.

Hyperostoses are best let alone, even in those cases in which they encroach upon the canal to such an extent as to decrease greatly its lumen. If from time to time the patient becomes deaf from an accumulation of cerumen between the hyperostoses, this should be picked carefully away by means of an appropriate instrument. The syringe should *not be used* unless absolutely necessary, because it is often difficult to remove fluid from behind the exostoses after syringing, and it may be the cause of an inflammation of the auditory canal and drum-head exceedingly difficult to control. Where the presence of hyperostoses seriously interferes with proper drainage in cases of purulent otitis an attempt should be made to effect a removal of one or more of the growths by means of a drill propelled by an electric motor.

Foreign Bodies.—Animate and inanimate objects, impacted cerumen, and laminated epithelial plugs are found in the auditory canal.

Animate objects that may enter the auditory canal are flies and other insects, the larvæ of insects, and various moulds.

The *treatment* when the auditory canal is invaded by a growth of Aspergillus, Mucor, or other moulds has already been detailed (p. 347). Insects can generally be removed readily by means of the syringe. The larvæ of insects are not usually present unless there be suppuration of the middle ear, but cases have been reported of the presence of maggots within the auditory canal when the drum-head was intact and no suppuration existed. Larvæ can be killed

with chloroform vapor and then removed by means of the syringe.

It is not permissible to drop chloroform into the auditory canal as a blister may result. A part of a drop may be absorbed by a small amount of cotton, which in turn is surrounded by sufficient cotton to make the plug fit snugly into the canal. Used in this manner the chloroform evaporates from the cotton into the canal, and the vapor produces a sensation of warmth and comfort. However, if, after a few moments, the application becomes painful it indicates that the chloroform vapor has penetrated the auditory canal in too large an amount, and the plug of cotton should be loosened or withdrawn from the canal entirely for a few moments, and then, if necessary, reinserted.

Generally the pain caused by the movements of the insects ceases within a few seconds after the use of the chloroform vapor and the insect may then be removed by syringing or, if necessary, with the forceps. In the case of ants, wood-ticks, or other insects that sometimes attach themselves to the canal or the drumhead by their strong mandibles or jaws the death of the insect is not always followed by a release of its hold upon the tissues. Under such circumstances the dead body of the insect can be removed by a pair of forceps. In the case of the wood-tick a portion of the tissue to which it has attached itself may be drawn out with the insect. This is a matter of no great consequence when the insect has attached itself to a portion of the canal; but irreparable mischief might be done by ill-considered efforts at removal when the insect has attached itself to the drum-head. In cases where, because of the nervousness of the patient or swelling of the canal, it is impossible at once to remove an insect that has been chloroformed, the canal should be filled with fluid vaselin or some other bland oil to prevent the resuscitation of the insect should the amount of chloroform vapor have proved insufficient to have caused its death.

Inanimate Objects.—Shoe-buttons, pebbles, glass beads, the ends of lead- and slate-pencils, and other objects are sometimes placed by children within their ears in a spirit of mischief. It is not rare for aurists to find parts of an onion

or pieces of cotton that were placed within the auditory canal by patients perhaps months or years before and forgotten. The writer removed from an old gentleman's ear three little wads of cotton which had been placed there several years before when he was treating himself for what he stated was "a boil in his ear." On one occasion, having demonstrated the removal of a foreign body from the ear of a dispensary patient before a ward class of ten or twelve senior students, the writer was requested by one of these students to examine his ear as he thought he had got sand in it while bathing at Atlantic City the previous summer. There was removed not only a small amount of sand but also a cherry stone, shrunken and black from age, which the student stated he dimly remembered having placed in his ear when a child. From the ear of another member of this same class was removed a small wad of cotton which the student stated must have been placed there the winter before.

These stories are worth relating, as they illustrate how little annoyance foreign bodies in the ear sometimes cause. On the other hand, impacted cerumen and other foreign bodies are said to have been the cause of persistent cough, nausea, and even epilepsy. As some sensitive patients cough almost continually while their ear is being cleansed and more especially when the floor of the canal at the junction of the cartilaginous and bony portion is rubbed with a probe, while others become faint and nauseated under similar circumstances, it readily is understood how in a neurotic or hysteric individual the presence of a foreign body in the ear might be the cause of such unusual symptoms.

Among the foreign bodies may be classed impacted cerumen and laminated epithelial plugs.

Removal of Foreign Bodies.—Leaves of the onion, wads of cotton, and other soft objects are readily grasped by mouse-toothed forceps and extracted. Hard, round objects, such as shoe-buttons and glass beads, should at first be attacked by means of a syringe. A fine cannula should be placed in such a position that a stream of fluid can be thrown into the auditory canal past the object. If careful syringing in this manner fails to dislodge the foreign body, a delicate

hook, made by bending the end of an Allen's probe at a right angle (Fig. 202), should be introduced into the canal between its wall and the object, and an effort made to *roll* the object outward through the canal. Hard, irregularly shaped bodies that cannot be rolled out with a hook or grasped by the forceps will often tax the ingenuity of the surgeon to effect their removal. In such cases strong cement or glue may be smeared on the outer surface of the foreign body and then a small mass of cotton applied. After a day or two, when the cotton is firmly attached to the foreign body, the cotton can be grasped with forceps and the foreign body removed.

Efforts at removal of foreign bodies should always be made with extreme gentleness, for fear of injuring the drum-head, and the surgeon should bear in mind that rather than incur the risk of doing so it is preferable to detach the auricle from the bony meatus by means of an incision made

FIG. 202.—Allen's probe bent to hook cerumen, etc.

posterior to the auricle, and turn the auricle and cartilaginous meatus forward upon the cheek.

In children it is generally necessary to give an anesthetic to secure that perfect quiescence of the patient necessary for the delicate and careful manipulation of instruments. In difficult cases it is best not to prolong unsuccessful efforts to remove a foreign body, for often it will remain in the auditory canal for years without producing any serious symptoms. In cases where it has been impossible to remove the foreign body at the first sitting, time should be given for the inflammation to subside, and after all swelling of the auditory canal has subsided efforts for the extraction of the foreign body will finally prove successful. Seeds and other objects that have swollen by the absorption of water may be dehydrated and shrunken by the instillation of alcohol.

Cases in which the uninitiated, by injudicious and unsuccessful efforts to remove a foreign body, have ruptured the drum-membrane and caused acute purulent inflammation

of the middle ear, and in which so much swelling of the canal has arisen that nothing can be seen, should be treated by frequent syringings with warm water and by the use of a hot-water bag, if necessary, to relieve pain until the inflammatory symptoms have subsided and the foreign body can be seen. No attempt at its removal should be made until swelling has subsided and the speculum can be used without causing pain.

Impacted Cerumen.—*Subjective Symptoms.*—There usually is a sense of fulness and itching, and the patient complains that he has suddenly become deaf in one ear without any previous symptoms of inflammation. The explanation of this fact is that so long as there is the smallest conceivable opening through a mass of cerumen it will be sufficient to transmit sound-waves and the hearing will not be greatly impaired. Sometimes a small opening through a mass of cerumen will close from time to time during damp weather and open again when the atmosphere becomes dry. This phenomena may be repeated many times, the patient being deaf only during damp weather. Even when impacted cerumen is present in both auditory canals the patient usually becomes deaf in one ear first. Under such circumstances the larger amount of inpissated cerumen may be removed from the ear in which the hearing is the most nearly perfect; sometimes after the patient has protested that "there is nothing the matter with that ear."

Etiology.—Increased secretion of cerumen is usually the result of disease of the middle ear or of catarrh of the nose and throat. It is rather unusual to find the hearing perfect after the removal of a mass of impacted cerumen. The introduction of irritants within the auditory canal increases the secretion of cerumen.

This is true of dusty employments, like coal-mining, stoking, or milling. Under such circumstances the mass of cerumen removed may consist partly of coal-dust or flour introduced into the canal by the dirty fingers of the workman while endeavoring to relieve the irritation of the canal by scratching it. Impactions result from ill-advised efforts to cleanse the canal by inserting into it the screwed-up corner of a towel or the clumsy use of a match-

stick or ear-spoon. When such articles are used dead epithelial scales and inspissated cerumen are thrust deep into the canal, which, if left to themselves, would have scaled off or exfoliated and dropped out of the canal. Hence the well-known saying that has come down to us from the aurists of half a century or more ago, "An individual should not put into his own ear any instrument smaller than his elbow."

Treatment.—If the mass be soft, syringing with warm water will quickly remove it, inspissated cerumen being soluble in water. If, however, the accumulation is very hard and dry and is mixed with a considerable proportion of epithelial scales, the mass may be softened by directing the patient to fill the canal with warm water several times a day before efforts at removing the mass are attempted. This plan is probably advisable for those who have had little experience with the manipulation of instruments within the auditory canal. Although inspissated cerumen is perhaps as readily soluble in water as any other bland fluid except peroxid of hydrogen, olive oil or a mixture of water, glycerin, and bicarbonate of sodium (20 gr. to 1 ounce) is sometimes prescribed, to be dropped into the ear several times a day, to soften inspissated cerumen before efforts are made to extract the mass by syringing.

However, it should be borne in mind that the hearing will be temporarily impaired as the result of dropping any fluid into the auditory canal when it contains a considerable quantity of cerumen, for reasons stated above. After the lapse of a few hours the wax may in rare instances have been increased in bulk sufficiently to cause pressure pain. When the surgeon is sufficiently expert with hook and syringe, it is never necessary to employ any fluid to soften the cerumen, the removal of the hardest and largest specimens being the work of only a few moments.

When the impacted cerumen is very hard and firmly fixed within the auditory canal it is probably best not to attempt to remove it by syringing until the mass has been rendered movable by manipulation with instruments. For this purpose the tip of an Allen steel probe, bent at a right angle (Fig. 202), should be introduced flatwise between the

wall of the canal and the cerumen until it has penetrated a short distance, when the hook should be turned into the mass of cerumen and gentle traction exerted. Generally there will be detached a small portion of the impacted cerumen, which can easily be removed from the canal. Proceeding carefully in this manner, it is sometimes possible to remove, even in those cases in which the wall of the canal is very sensitive, the entire mass of impacted cerumen without causing even the slightest pain or congestion of the

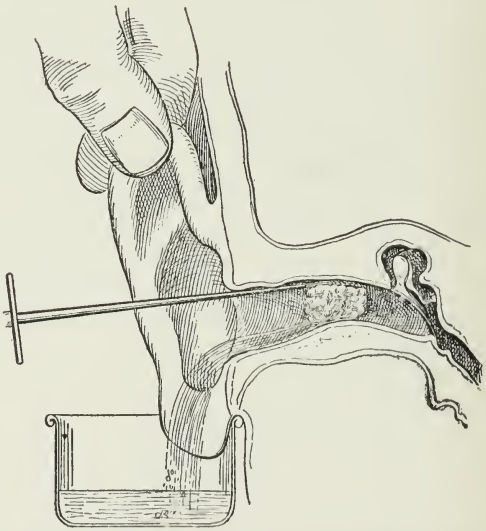


FIG. 203.—Washing impacted cerumen from canal. Showing how to hold auricle to straighten canal and where to direct the stream of water.

drum-head, the procedure being vastly less disagreeable to the patient than syringing. However, it is best in many instances to desist as soon as the mass of cerumen is felt to be movable and resort to the syringe. The syringe used by dentists to cleanse carious cavities in teeth (Fig. 38, *c*, with nozzle 8) is an admirable instrument for syringing cerumen from the ear. The stream of fluid should be thrown behind the impacted cerumen through the opening that has been made by an instrument (Fig. 203). One or two syringefuls of warm water will probably suffice to remove the greater

portion of the cerumen, after which the auditory canal should carefully be cleansed of any remaining flakes by a dossil of absorbent cotton wrapped about the end of an Allen probe and dipped into a solution of peroxid of hydrogen.

A metal ear-spout (Fig. 204) will be found convenient to receive the fluid from the auditory canal during the syringing. It should be borne in mind that syringing an ear is at best a disagreeable procedure, and that the injection of water either too cold or too hot or with too much force into the auditory canal is usually followed by syncope. The writer once saw in the dispensary a patient drop from the stool on which he was seated as suddenly as if he were shot. A student was attempting to remove impacted cerumen by syringing, and had inadvertently injected cold water into the patient's ear with considerable force. Where the quantity of cerumen is so large that it is impossible for the first syringeful to reach the drum-head, it is justifiable to inject with considerable force, but as the tympanum is approached judicious gentleness should be employed. Especially where the drum-head is lacking, syringing the ear may be made absolutely intolerable by want of gentleness and judgment on the part of the operator.

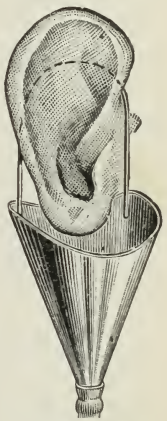


FIG. 204.—Metal ear-spout.

Keratosis Obturans or Epithelial Plug.—The name "keratosis obturans" was applied by Weeden of St. Petersburg to epithelial laminæ impacted within the auditory canal in contradistinction to "cerumenosis obturans" or impacted cerumen. In masses of impacted cerumen there are more or less epithelial laminæ. However, the typic laminated epithelial plug consists almost entirely of laminæ of epithelium packed one about the other. The external end of such a mass is generally covered by inspissated cerumen which, of course, is easily removed by syringing when the laminæ of closely packed epithelial scales are exposed to view, looking not unlike a plug of wet chamois skin. It is impossible to remove such an accumulation by syringing.

It is necessary to effect its removal layer by layer by means of a hook, a curet, or by forceps. A laminated epithelial plug is composed of the horny layer of the cutis of the auditory canal, which accumulates, layer by layer, within the canal as the result of desquamative inflammation. After the removal of a laminated epithelial plug the membrana tympani will probably be found normal in appearance and the hearing be perfect. Usually this is not the case when the collection within the canal consists of a cholesteatomatous mass.

Aural Cholesteatoma.—The name "aural cholesteatoma" is sometimes applied to a true new growth within the temporal bone, similar to cholesteatomata found in other bones of the skull. Ordinarily, "cholesteatomatous mass" means an accumulation within the auditory canal and tympanum of a mass consisting of epithelial scales, cholesterin crystals, and inspissated pus, derived by desquamative inflammation from the lining membrane of the tympanum or mastoid cells.

The presence of cholesteatomatous masses usually causes impaired hearing, tinnitus, and sometimes nausea and dizziness. The bony and soft structures often become absorbed as the result of the pressure caused by the accumulation of cholesteatomatous material, so that cholesteatomatous accumulations are sometimes found occupying large cavities—so large, indeed, that in one instance the cavity from which a cholesteatoma was removed involved the greater part of the auditory canal, the whole of the tympanum, and a large part of the mastoid and petrous portion of the temporal bone.

Small collections of cholesteatomatous material are common at the upper and posterior portion of the auditory canal in cases in which perforation of Shrapnell's membrane has occurred. The mass often extends into the attic of the tympanum, sometimes into the mastoid antrum. Cholesteatomatous masses are usually not easily detected at the first glance. Sometimes a small mass projecting into the meatus will be the only evidence of the presence of a cholesteatoma of considerable size. If, however, the small mass projecting into the canal be removed, other masses

will be found, until in some instances a cavity of considerable size will have been emptied of its contents. The beginner in otology should be on the lookout for accumulations of this kind and should not consider his otoscopy completed until all visible parts have received the closest scrutiny and been thoroughly cleansed.

Etiology.—When the membrana tympani is perforated as the result of disease or operative interference the opening in the drum-head generally promptly closes. If, however, a large portion of the drum-head is destroyed as the result of long-continued suppuration, the epidermis of the canal proliferates over the margins of the perforation and prevents its being filled by granulations; so that the perforation tends to become permanent. Furthermore, under certain conditions the epidermis of the canal proliferates over the walls of the cavities of the middle ear, and a greater or less extent of surface assumes a skin-like character and appearance. The entire tympanum, aditus and antrum, may become epidermized, but generally the epidermis extends but a short distance into the tympanum.

When the attic and antrum become epidermized their lining membrane exfoliates as the result of chronic inflammation, and epidermic scales unless removed accumulate until the entire cavities become filled, as shown in Figs. 233, 234.

Occasionally the presence of a small collection of cholesteatomatous material in the attic will cause a small amount of discharge through a fistula over the drum-head, and this scanty discharge, drying almost as it is secreted, sometimes forms closely adherent casts of the drum-head that might easily be mistaken for the drum-head itself. The removal of such casts from the drum-head is generally followed by considerable improvement in the hearing.

Although Toynbee refers to collections of cholesteatomatous material under the name of "pearly or molluscous tumors," and evidently thought that they were derived from the epidermis of the auditory canal, and Hinton, Kupper, and Wendt refer to similar collections derived from the epidermis of the drum-head, yet the majority of authors who wrote previous to the last decades taught that cholesteato-

mata were due to the retention of the products of inflammation of mucous membranes. The fact that cholesteatomata are not infrequently found within the middle ear when the drum-head is intact and there is no communication between the auditory canal and the cavity containing the mass seemed to favor this view, but it should be borne in mind that perforations of the drum-head may persist for years and finally close.

DISEASES OF THE MIDDLE EAR

THE MEMBRANA TYMPANI

When inspecting those parts of the ear visible by otoscopy the attention of the observer should be particularly directed to the size of the auditory canal and the condition of its wall. Every little scale of epidermis or mass of cerumen that can possibly hide an abnormal condition should carefully be removed by means of a cotton-tipped probe. The observer's eye should next seek the umbo or depression near the center of the drum-head, and the glance should then be directed upward along the handle of the malleus until Shrapnell's membrane is brought into view. This portion of the membrane should receive the most careful scrutiny, an effort being made to discover, if possible, the presence of the so-called *foramen of Rivini* or anything abnormal in this region. Attention should next be directed to the condition of the anterior and posterior folds, after which the glance of the observer should be directed around the periphery of the drum-head. By observing always this or some other definite plan of examination during otoscopy it will hardly be possible that any abnormal condition of importance will escape observation.

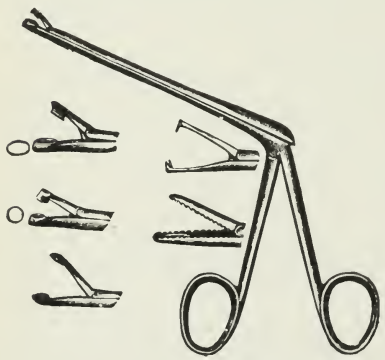


FIG. 205.—Foreign-body and polyp forceps (after Hartmann).

Particular attention should be directed to the size, shape, and position of the cone of light, the apparent length and position of the malleus handle, and the degree of prominence of the short process; the color, lustre, apparent thickness, curvature, and position of the drum-head; as well as the presence or absence of perforations, cicatrices, chalk deposits, localized spots of atrophy or thickening, polypi, abscesses, exudation-cysts, or other pathologic conditions.

Changes Occurring in the Curvature of the Membrana Tympani.—The membrana may bulge outward as the result of pressure from fluid within the tympanum or there may be a

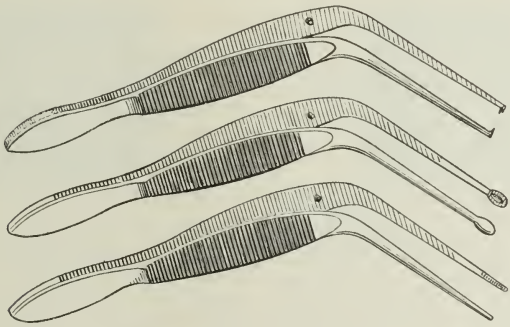


FIG. 206.—Politzer's ear forceps.

localized "pointing" of pus at any position on the drum-head. The normal curvature of the drum-membrane depends largely upon the tension of the tensor tympani muscle. It is claimed that the rectractile effect of this muscle is increased after death by rigor mortis and in certain conditions the muscle is constantly contracted during life to an extreme degree.

An unduly depressed condition of the membrana tympani also occurs as the result of unequal pneumatic pressure upon its two surfaces, when obstruction of the Eustachian tube interferes with the proper ventilation of the tympanic cavity. Sometimes the retraction of the membrane is quite abrupt at points near the periphery, so that a sort of terrace is formed at that point. Under such circumstances a bright

line will be seen at the point where the abrupt change of curvature occurs. Should such an abrupt change of curvature occur at the position of the cone of light it will appear as if broken transversely into two parts, that nearest the periphery assuming a crescentic shape. Whenever the membrane is retracted as a whole there is usually some change in the light spot. It often loses the triangular form, because of which it has received the name "cone" or "pyramid of light," and becomes narrow, reduced to a mere point, or perhaps entirely disappears.

The posterior fold becomes large and prominent when the drum-membrane is greatly retracted and the malleus handle

FIG. 207.—Retracted membrane of a girl of ten years, with long-standing nasal and tubal obstruction, showing foreshortening of malleus handle, prominence of the posterior fold, and visibility of the margin of the pocket of von Troelsch as it passes forward to the manubrium. The light spot is shortened, and beyond it anteriorly are two parallel curvilinear bright lines, marking the edges of abruptly depressed areas of the drum-head, one within the other (Randall).

FIG. 208.—Left membrana tympani of a boy of six years, with nasal and tubal obstruction. Manubrium drawn up almost out of sight, the tip being higher than the short process; behind it the incudostapedial joint is visible, and below and posteriorly the dark niche of the round window is discernible. There is a faint reflection of light near the normal position, and a stronger one on the promontory near the stapes (Randall).

foreshortened (Fig. 207) or displaced, usually backward (Fig. 208). The two diagrams (Figs. 209, 210) represent the means by which the apparent shortening of the malleus handle is produced.

Myringitis is an inflammation of the membrana tympani, characterized by congestion, swelling, and sometimes ulceration of the membrana tympani, pain, and tinnitus; but hearing is not greatly impaired unless the inflammation also involves the entire tympanic cavity. The pain is increased by movements of the jaw, pressure in front of the tragus, or traction upon the auricle; it is generally shooting rather than throbbing in character.

Etiology.—The commonest cause of myringitis is ex-

posure to cold, especially the direct impact of a cold wind upon the membrana tympani in persons whose auditory meatus is unduly open. It is sometimes the result of direct violence, as, for example, a blow upon the auricle or the impact of a wave in surf-bathing. In some cases the etiology is obscure and the disease seems to be the result of struma or of the rheumatic or gouty diathesis.

Symptoms.—Severe pain, shooting in character, tinnitus, and more or less deafness. Upon inspection, if the disease is seen in its earlier stages, the membrane will be found markedly congested at the periphery and behind the malleus handle. Large vessels will be seen in these positions and radiating branches will extend from the blood-vessels behind

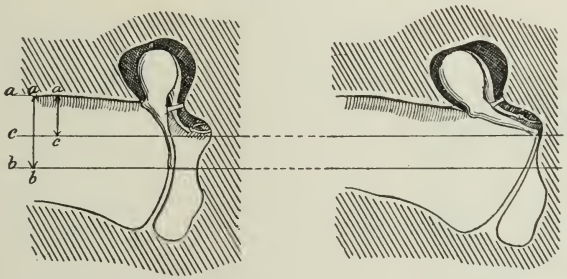


FIG. 209.—Diagram of the normal position of the malleus and membrana tympani. The apparent length of the malleus handle to the eye of an observer is represented by the distance *a–b*.

FIG. 210.—Diagram of a retracted membrana tympani, showing the malleus handle drawn backward until its tip is in contact with the promontory. The apparent length of the malleus handle to the eye of an observer is represented by the distance *a–c*, the apparent length of the malleus handle having been "foreshortened" about one-half.

the malleus handle to inosculate with those coming from the periphery. The surface of the membrane becomes lustreless and rough from loosening of its epithelium, and thick and opaque and of a uniform reddish color from infiltration and increased congestion, until all landmarks except the short process of the malleus handle are hidden from view, this too finally disappearing beneath the swelling, the membrane being, at this stage of the disease, of a lively red color and apparently either flat or actually convex in form. As the integument in the neighborhood of the drum-head is also congested it is difficult to make out its boundaries,

the red and convex membrane appearing not unlike a polypus projecting into the canal, for which it has been mistaken.

In the course of the disease the epidermis exfoliates, wholly or partly, and there appears an abundant secretion, which is at first serosanguineous, but later becomes purulent. Exudation-cysts, filled with serum or pus, sometimes appear upon the surface of the drum-head. Pressure with a probe will indent such collections of fluid between the layers of the drum-head and the indentation will remain visible for some time (Fig. 211), which is not the case in localized pointings of pus from within the tympanum. If abscesses rupture or are incised, ulcers result, which may either heal or perforate the drum-head.

As the inflammation subsides the portion of the membrane at the umbo is the first to resume its normal appearance. The periphery of the drum-head and a triangular portion, whose base includes Shrapnell's membrane and whose apex is at the tip of the malleus handle, remain red and swollen for some days. Finally the swelling and congestion disappear from these parts of the membrane, the light spot becomes distinct, and the drum-head assumes its normal appearance.

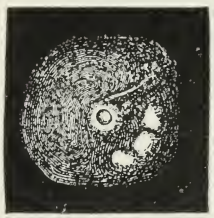


FIG. 211. — Interlamellar abscesses of right membrana tympani, one at umbo showing the pitting caused by pressure of a probe. Three others are seen down and forward (Schwartze).

Relapses are not infrequent or an acute attack may assume the chronic form of the disease.

Treatment.—In acute cases pain may be relieved by the application of leeches and afterward by the use of hot fomentations. When a discharge appears the parts should be thoroughly cleansed by means of a dossil of cotton dipped into peroxid of hydrogen and the membrane should be covered with a thin coating of powdered boric aid. In traumatic cases the pain and congestion rapidly subside under 1-drop doses of tincture of aconite-root administered every hour. A 4 per cent. solution of cocain should meanwhile also be dropped into the auditory canal sufficiently often to keep the parts moistened until the pain subsides.

Chronic Myringitis.—Chronic inflammation of the drum-head is practically always present in chronic otorrhea originating in the tympanic cavity. In such cases the chronic myringitis is part of the intratympanic inflammation and generally subsides after the discharge has ceased. The perforation, if not too large, then closes spontaneously or can be made to close by one of the methods described in the section on Perforations of the Membrana Tympani.

However, chronic myringitis is occasionally encountered without a history of previous middle-ear otorrhea, and then generally is part of a chronic inflammation involving at least the deeper portion of the auditory canal.

Etiology.—Gout, rheumatism, or struma may account for the cases of chronic myringitis when there is no history of a previous otorrhea. Most cases are, however, the heritage of a middle-ear suppuration, and in cases where there is a scanty fetid discharge in the fundus of the canal it is well to inspect the posterior upper quadrant of Shrapnell's membrane closely for a fistula leading into the attic before being satisfied that the drum-head is intact.

Symptoms.—The subjective symptoms are a sensation of fulness and itching within the ear. As the drum-head has little to do with the function of hearing, the hearing in these cases is only slightly impaired unless the intratympanic structures are involved. There is sometimes a very scanty fetid discharge. This discharge adheres to the drum-head and collects in small amounts upon the adjacent lower portion of the canal. When wiped away with cotton and peroxid the drum-head is reddened, either as a whole or in spots where the epithelium has exfoliated. Some of these areas mark the position where a minute abscess has ruptured and may be covered with granulations or minute polypi. In cases where there is no discharge the drum-head lacks lustre and is rough from the loosening of its epithelium. The color of the drum-head varies according to the degree of the inflammation from a dull red to a yellow or dirty white. It is no longer translucent, but is thick and opaque. The cone of light is absent or small and distorted.

Prognosis.—The course of the disease is slow. Chalk

deposits and areas of localized thickening or atrophy are not uncommonly seen when the disease has run its course.

Treatment.—When chronic myringitis is part of an inflammation of the other anatomic structures of the tympanum the treatment is largely that of the intratympanic condition.

In cases where there is a *discharge* from the dermic surface of an intact drum-head, this should be cleansed carefully by syringing first with warm water and afterward with sublimate solution. The canal should then be dried thoroughly by means of absorbent cotton wrapped about the end of an Allen's probe and painted with a 60-gr. solution of nitrate of silver.

Abscesses, if present on the drum-head, should be evacuated and the interior of the abscess touched with nitrate of silver by means of a bead of the salt fused on the end of a probe.

Granular spots and small *polypi* upon the drum-head should receive special attention. Where the granulations are small, simply thoroughly applying at intervals of three or four days a 60-gr. solution of silver nitrate is sufficient to bring about a cure. When the granulations are larger and coarser it will be necessary to destroy them with a 50 per cent. solution of chromic acid or by touching them with trichloracetic acid. These applications should be made with care, so that no dip of acid is allowed to flow or spread beyond the bounds of the granular area. Polypi too small to be removed with a snare should be scraped away from their place of origin on the membrana by means of Buck's sharp curet or removed by means of Hartmann's curet forceps (Fig. 205).

In cases where the granulations on the drum-head are coarse or a small polypus has been removed, the patient should be instructed to drop into his ear 95 per cent. alcohol (diluted if necessary) every three hours between his visits to the aurist (Formula 49).

Nitrate of silver in strong solutions was extensively used by the aurists of half a century ago as an application to the drum-head. Wilde believed that it brought about exfoliation of the dermic layer of the membrana and thus dimin-

ished its thickness. While these views of this distinguished Dublin aurist are not exactly in harmony with modern teaching, yet it is probable that the silver oxid deposited upon the dermic layer of the drum-head as the result of applications of nitrate is partly absorbed by the deeper structures, acts as a sedative, and promotes the absorption of inflammatory products.

For cases that result from a rheumatic or gouty diathesis, alkalies, with iodid of potassium or salicylate of sodium, should be prescribed, while for cases where the disease results from struma or debility the use of tonics and cod-liver oil and the employment of hygienic measures should be advised.

Deposits of chalk (Fig. 218) are usually the result of *long-continued inflammation* of the membrana tympani. Their presence does not indicate that the patient has the gouty diathesis. Only when large do they greatly interfere with the acuteness of hearing by stiffening the drum-head and interfering with its vibrations.

Rupture of the drum-head may result from the direct impact of a foreign body or from the instruments used in extracting a foreign body. Many cases are the result of the sudden compression of the air in the auditory canal produced by falls or blows upon the ear or the discharge of large cannon when the patient occupies a position near the mouth of the gun, etc.; and when the membrane is diseased, from the use (abuse) of Politzer's air-douche, Siegle's pneumatic speculum (probably the more dangerous instrument), and even from violently blowing the nose. The writer observed a case of this kind in an old lady of about seventy, whose drum-head, aside from the usual senile changes, so far as could be judged by her history and the appearance of the other drum, was normal previous to the accident. Another case was that of a robust young man who attributed his ruptured drum-head to a kiss on his ear.

The drum-head may or may not be ruptured in fractures of the base of the skull. Even in such cases, where there is hemorrhage from the meatus, the blood may come through the roof of the canal and the membrana tympani be intact, as in a case observed post mortem by the writer.

Injury to the drum-head may result from *contrecoup* or be explained by the irradiation theory of Aran.

One of the writer's cases, a lad of about sixteen years, exhibited rupture of both drum-heads as the result of a blow from a baseball received on the left mastoid. It is stated that gunshot wounds of the mastoid may cause rupture of the drum-head apparently as the result of the jar from the impact of the bullet. However, it should be remarked in this connection that a hard blow from the bare fist on the ear is far less likely to produce rupture of the drum-head than a lighter blow from the palm of the hand or a boxing-glove, the rupture in the latter case resulting from the condensation of air in the canal.

FIG. 212.—Rupture of the antero-inferior half of the drum-head, caused by a box on the ear (after Politzer).

In rupture of the drum-head resulting from the concussion of cannon shots, bursting shells, etc., there is apparently, if one may judge by the stellate scars seen in cases where the victims have escaped with their lives, actually a tearing out of a portion of the drum-head, usually just below the tip of the malleus.

The *subjective symptoms* are sudden deafness, tinnitus, vertigo, and hemorrhage or a serous discharge from the ear.

The *prognosis* as regards the restoration of hearing depends upon the amount of damage done to the other structures of the ear. Most uncomplicated cases recover satisfactorily and speedily, but sometimes purulent inflammation of the middle ear follows as the result of the injury or injudicious treatment.

Treatment.—Cleanse the external auditory canal carefully, so as to remove all blood-clots or other material that might favor the growth of bacteria. Use Politzer's air-douche if necessary to remove blood from the middle ear or little shreds remaining between the edges of the wound to retard union; apply by means of the powder-blower a thin layer of boric acid upon the drum-head, and *let the ear entirely alone* until the healing process is complete, unless pain or the appearance of a purulent discharge renders further interference necessary.

Perforation of the membrana tympani sometimes occurs as the result of ulceration from the dermic surface of the drum-head during an attack of acute myringitis. Under such circumstances the ulcer is usually *central.* The commonest cause, however, of perforation of the membrane is ulceration from within, the result of otitis media purulenta.

Symptoms.—Examination by means of the concave mirror and speculum usually discloses the presence of the perforation, which, if large, is readily seen. In most cases inflation of the middle ear by the Politzer method produces a characteristic "perforation whistle," readily heard by means of the auscultation-tube (Fig. 189). Indeed, the perforation whistle is often so loud that it can be heard at a distance of many feet from the patient. If suppuration of the middle ear is present pus will escape through the perforation in the form of bubbles during inflation.

FIG. 213.—Right membrana tympani of a boy of five years, with constant discharge for three years. A perforation about 1.5 mm. in diameter is with difficulty seen above the short process, and intratympanic injections bring away epithelial flakes and masses of fetid secretion. The rest of the membrane is slightly opaque, thickened, and injected (Randall).

The subjective symptoms vary according to the size and position of the perforation and other diseased conditions of the ear that may be present. A perforation of Shrapnell's membrane (Fig. 213), when it has been present for some time, is usually accompanied by considerable hardness of hearing, because purulent inflammation of the attic, the commonest cause of perforation in Shrapnell's membrane, generally involves the articulations of the ossicles and produces lesions which greatly impair the acuteness of hearing. When the perforation is near the center of Shrapnell's membrane the neck of the malleus is exposed, while perforation through the anterior portion of the drum-head, being directly over the tympanic extremity of the Eustachian tube, yields a loud perforation whistle. Rivini has described a perforation or foramen existing in the membrana flaccida as a normal condition. Although such a "foramen"

is frequently seen just above the short process, it is believed by most aurists to be pathologic.

When a large perforation in the membrana vibrans involves a considerable part of the malleus handle the tip of this process is usually destroyed by necrosis; should, however, the malleus handle become attached to the promontory this does not occur. Large perforations may exist in the membrana vibrans without the hearing being greatly impaired, unless the perforation be so placed as to impair the support that the membrana normally gives to the ossicles.

Prognosis.—Perforations of considerable size permit free access of dust, cold, moisture, and other irritants into the tympanic cavity, and predispose the patient to recurring

FIG. 214.—A large rounded loss of substance of the membrana tympani below reaches up to the tip of the manubrium, which projects slightly into the upper margin. It is closed by a delicate cicatrix applied to the promontory and molded upon its inequalities. The edges of the depression are sharp cut and overhang, so that the area seems an unclosed perforation (Randall).

FIG. 215.—Inflation of the middle ear forces the delicate cicatrix out like a bubble into the meatus, where it seems larger than the opening and hides its edges and the handle of the malleus. In a few minutes the distended sac loses its tension and becomes plicated as it collapses, soon to resume its old position in contact with the inner tympanic wall (Randall).

attacks of otitis media. Sometimes the perforation gradually becomes closed by cicatricial material. Indeed, nearly the whole drum-head may be replaced in this manner. But, although the tympanic cavity is by this means protected from cold or dust-laden air, *the acuteness of hearing* is generally more or less impaired if the surface of cicatricial tissue be large, and such cicatricial areas break down readily during attacks of acute catarrh of the middle ear.

When seen by reflected light cicatricial areas generally appear somewhat depressed below the level of the rest of the drum-head, and they are sometimes so transparent that the structures within the tympanum are readily discernible

through them (Fig. 214). If rarefaction of the air within the auditory canal is produced by Siegle's pneumatic speculum, a cicatrice will be seen to move farther outward than the rest of the membrane. When large and very thin and lax, a "ballooning" of the cicatrice results from inflating the middle ear by means of Politzer's air-douche (Fig. 215).

Treatment.—When all discharge has ceased from the tympanum an effort should be made to close the perforation in order to prevent the irritating effects of dust and cold upon the exposed intratympanic mucous membrane. Closing of the perforation, when small, can be brought about by rubbing its edge from time to time with a few fibers of absorbent cotton wrapped about the end of an Allen probe and saturated with fuming nitric acid. The acid destroys the epidermal scales or cells which otherwise would extend from the external or dermal surface of the drum-head and prevent the growth of granulations. By keeping the edge of the opening in the drum-head "raw"—that is, free from epidermis—by means of the acid, the granulations finally unite in the center of the perforation, which then becomes closed. The same thing can usually be accomplished by the method devised by Blake, which consists in placing a little disk of writing-paper over the perforation. A disk of sufficient size to cover the opening is cut from ordinary writing-paper and is soaked for a few moments in corrosive sublimate solution (1 : 5000). It is then placed on the end of a cotton-tipped Allen probe and carried through a speculum to the drum-head over the perforation. It adheres somewhat firmly to the edge of the perforation because of the sizing or glue which all writing-paper contains.

The paper disk acts as a stimulant and support to the granulations springing from the edge of the perforation, so that they finally unite in the center and the opening is closed. It is somewhat instructive to note from week to week the changing position of the disk of paper. Roughly speaking, the epidermal scales grow from the center of the drum-head toward its periphery, and thence outward along the canal, and hence the disk of paper which was placed over the perforation in the drum-head within a few weeks is

seen to be upon the wall of the canal. If, in the meanwhile, the perforation in the drum-head has not closed, another disk of paper should be placed over it, and so on until the perforation has closed.

When a perforation is so large that the support of the tympanic membrane to the ossicles is destroyed the chain of small bones tends to sag outward by its own weight, and the acuteness of hearing is considerably impaired. If the Toynbee artificial membrana tympani (Fig. 216) be so placed as to give the requisite amount of support when this condition exists, considerable improvement of the acuteness of hearing will result; but little disks of paper, linen, silk, or compressed cotton answer a still better purpose, and a thread may be passed through the center of such a disk to facilitate its removal from the auditory canal. Gruber has contrived an apparatus (Fig. 217) for the introduction of such artificial drum-membranes by the patient himself, who, after a little preliminary instruction, can usually introduce one in a manner to secure the greatest increase of the hearing power. It is astonishing how tolerant the ear sometimes becomes to the presence of such objects, which can often be used for a long time without any deleterious results. It is not a matter of indifference as to the material employed in the manufacture of the artificial drum-heads. Some patients hear best with disks made from one material, some with those made from another.

FIG. 216.—Toynbee's artificial drum-head.

FIG. 217.—Contrivance for introducing artificial drums (Gruber).

FIG. 218.—Calcareous deposits in the drum-head after middle-ear inflammation (Spalding).

When a large cicatrix is present which bulges greatly after inflation—*i. e.*, is very freely movable—the hearing can often be improved greatly by the application of a small quantity of contractile collodion (Formula 88). The collodion is best applied by means of a small camels'-hair brush after the inflation of the tympanum. The application of collodion should not be repeated at too frequent intervals or too much applied at one time, because pain and myringitis may result.

DISEASES OF THE TYMPANUM

Otitis Media Catarrhalis Acuta.—Acute catarrhal inflammation of the middle ear is an acute inflammation of the mucous membrane of the tympanum, Eustachian tube, and, sometimes, of the mastoid cells, characterized by increased secretion of serum or mucus, but not of pus. Clinically, cases of acute catarrh of the middle ear are divided into two classes: One in which the attic of the tympanum and mastoid antrum are involved by the diseased process; the other, in which the disease is confined to the Eustachian tube and atrium of the tympanum.

Synonyms.—According to the character of the secretions the names applied are otitis media serosa acuta, otitis media mucosa acuta, and otitis media non-purulenta; according to the parts principally involved in the diseased process: Otitis media catarrhalis ex tubæ, otitis media catarrhalis cum ostitide mastoidæ, acute Eustachian salpingitis, etc.

Etiology.—The disease is in almost all instances the result of exposure to cold. Chronic catarrhal affections of the upper respiratory tract render many individuals susceptible to recurring attacks of inflammation of the middle ear, while in many instances carious teeth have the same effect. Very often pain commences as a toothache, which pain extends to the ear. In many cases the disease is the result of surf-bathing or of diving into water from a considerable height.

In cases where acute catarrh results from diving and surf-bathing the direct impact of water upon the drum-head produces sufficient traumatism to cause the disease. A large auditory meatus, a cicatricial drum-head, or a perfo-

rated drum render the middle ear more liable to traumatism while bathing, and such individuals should never dive or bathe in the rough surf without stopping the ears with absorbent cotton saturated with vaselin to exclude the water. All amphibious animals have valves which exclude water from the auditory canal during the time the animal is under water and hunting dogs taught to dive sooner or later become deaf. However, it is not always the forcible entrance of even cold water into the auditory canal that is responsible for an attack of acute aural catarrh. Not infrequently in surf-bathing a wave will strike a bather in the face at a time when he is swallowing or performing some other function that opens the Eustachian tubes, and under such circumstances the water sometimes penetrates as far as the tympanum, and if not speedily removed is capable of causing acute intratympanic inflammation. An accident of this kind once occurred to the writer and was accompanied by a certain amount of vertigo and syncope, and it seems not improbable that some cases of drowning may be the result of the entrance of water into the ears during surf-bathing or swimming in rough water.

Occasionally fluid used as a nose-wash penetrates the Eustachian tubes and occasions acute tympanic catarrh or even suppuration, although the wash may be as bland and unirritating to the nasal mucous membrane as the normal salt solution. Bland oils may be thrown into the Eustachian tube with impunity, but watery solutions frequently cause mischief. The use of such contrivances for cleansing the nasal mucous membrane as Thudicum's douche, the Bermingham douche, etc., are by no means as safe as an atomizer, and acute catarrh of the middle ear has resulted from simply sniffing normal salt solution into the nose and blowing the nose forcibly immediately afterward, so that some of the fluid reached the tympanum. Should water reach the tympanum during bathing or a watery nose-wash be inadvertently injected into the middle ear while cleansing the nose, Politzer's or Valsalva's method of inflation immediately should be employed sufficiently often to free the middle ear from the fluid.

The exanthematous fevers, and occasionally typhoid and

tuberculosis, operations in the posterior portion of the nares, in the postnasal space, and even upon the tonsils occasionally cause acute otitis.

Pathology.—The affection in most cases begins as a catarrh of the pharyngeal orifices of the Eustachian tubes, accompanying similar disease of the nose and nasopharynx. If the pharyngeal orifice of the Eustachian tubes is inspected by means of the rhinoscope at the beginning of an attack the mucous membrane of the tube-mouths will be found so congested and swollen as to either completely close the tubes or at least greatly interfere with the proper ventilation of the middle ear. Later on the secretions from the tubes are abundant, becoming more consistent in most instances as the disease advances, so that a bulb of thick glue-like mucus may project from the orifices of the Eustachian tubes into the pharynx. The mucous follicles are sometimes swollen, giving a granular appearance to the tube-lips.

The appearance of the membrana tympani varies somewhat at the commencement of the disease. Generally it is pinkish in color, as the result of the congestion of the inner or mucous layer, and the manubrial plexus of blood-vessels is congested. Often the membrana is more dull and opaque than it is normally. Often a line as fine as a hair, extending across the drum-head, indicates the upper level of the fluid within the tympanum (Fig. 219). If the fluid within the tympanum is thin and mobile, it will be seen to alter its position with the movements of the patient or during the use of the pneumatic speculum. By inflating the middle ear by the Politzer method the fluid can sometimes be broken into foam and the dim outlines of minute air-bubbles discerned through the drum-head (Fig. 220).

The *bacteria* found in the secretion varies. However, there is practically never a mixed infection. The staphylococcus and the pneumococcus of Friedländer probably are the forms most commonly present.

The *prognosis* under appropriate treatment is favorable. Most cases completely recover. In neglected cases, however, the disease often assumes the purulent form or relapses into the chronic condition.

Symptoms.—Generally there is pain, increased by move-

ments of the jaw, pressure over the tragus, or gently pulling the auricle outward. Hardness of hearing will be greater than in simple myringitis, if, indeed, myringitis ever occurs without the inflammation involving, to a certain extent, the entire mucous membrane of the middle ear. There will be present tinnitus and perhaps vertigo. The appearance of the membrane varies according to the amount of myringitis present. It may bulge outward at certain spots from the pressure of fluid within the tympanum or the entire membrane may be flattened or even bulging as the result of the pressure of fluid within the tympanum. The color of the membrane may be nearly normal in appearance. There may be more or less congestion about the periphery or the

FIG. 219.—Collection of fluid exudate in the lower part of the tympanum, marked by a glistening line across the membrane. From the right ear of a young man in the middle of an acute coryza. Cure by Politzerization (Politzer).

FIG. 220.—Foamy secretion in the tympanum after inflation, in a case of serous accumulation. From a patient with acute nasopharyngeal catarrh (Politzer).

region of the malleus handle. In the later stages of the disease, if rupture of the drum-head be delayed, the swelling of the drum-head is so great that the outline of the malleus handle is lost to view and the drum-head is not distinguishable by color from the surrounding red and swollen skin of the canal.

Treatment.—In most cases of acute catarrh of the middle ear, if seen early, it is advisable to prescribe $\frac{1}{3}$ gr. of calomel combined with 5 gr. of the bicarbonate of sodium, to be taken every hour for six hours, for the double purpose of securing free evacuation of the bowels and the alterative effects of the calomel, as it has been maintained that small, frequently repeated doses of calomel have the power of controlling inflammation of mucous membranes.

The pain is often relieved by the use of *leeches*. It is customary, in cases where there is severe pain, to apply at least three leeches, one in front of the tragus, one on the mastoid as close to the auricle as possible, and one just beneath the auricle in the angle between the jaw and mastoid process. These points are selected because they are the positions where the circulation of the middle ear is most readily depleted. The leeches should be the largest procurable and the wounds should be encouraged to bleed for a time after their removal.

A half-century ago leeches were much more freely used in the treatment of acute aural catarrh than at present. Some writers of this period recommend that as many as ten leeches be applied to the margin of the auditory canal in relays; that is, as fast as one leech filled and dropped off a fresh leech was applied as nearly as possible to the same spot. It is certainly true that in order to relieve the pain of acute catarrh of the middle ear or myringitis the blood-letting should be somewhat free and that little relief will follow the use of less than three leeches. The use of leeches in the hyperemic stage of acute otitis media when the pain is severe will not only relieve the pain but also will often cut short the progess of the inflammation. After the use of leeches hot applications should be made to the ear. This can be done by filling the auditory canal with hot water and afterward applying a hot flaxseed poultice over the auricle, but in most cases pain is more quickly and completely relieved by the instillation of anodynes into the ear and the application of *dry heat*.

The patient may lie with the affected ear upon a hot-water bag or a bag of hot salt, and 1 or more drops of a 4 per cent. solution of cocain be placed within the auditory canal from time to time. In some cases, however, a combination of morphin and atropin (Formula 31) seems to act better as an anodyne than cocain. A hypodermic tablet of atropin and morphin may be dissolved in a few drops of warm water and dropped into the ear. It is best to use a certain amount of caution in the use of powerful narcotic poisons within the auditory canal, as cases of poisoning have been reported. It is a safe rule never to drop into the auditory canal a larger

amount of atropin or morphin than can safely be administered by the stomach.

It should be borne in mind in using anodynes within the ear that when the mucous membrane of the middle ear is exposed watery solutions are more readily absorbed than oily solutions or ointments, but that the contrary is the case when the drum-head is intact and absorption must take place through the surface of the skin; also that inflamed surfaces, whether of skin or mucous membrane, absorb anodynes much more slowly than when no inflammation is present. A 3 per cent. solution of cocain painted upon the exposed mucous membrane of the middle ear quickly relieves the pain of tympanic neuralgia, and more slowly that of active inflammation, but where the drum-head is intact a 10 per cent. ointment of cocain and lanolin will give greater relief from pain than a watery solution. However, in either the relief from pain is somewhat tardy if considerable inflammation be present.

When fluid is present within the tympanum an attempt should be made to evacuate it by the use of the *Politzer air-douche*. The nose and nasopharynx should first be cleansed by the spray from an atomizer containing an alkaline solution (Formulas 1 to 10) and a piece of absorbent cotton, saturated with a 4 per cent. solution of cocain, inserted within each nasal chamber. After contraction of the turbinated bodies has been secured, the nasal chambers and the vault of the pharynx should be sprayed with a 4 per cent. solution of antipyrin to maintain the effects of the cocain for several hours and relieve congestion of the pharyngeal lips of the Eustachian tubes. The Politzer air-bag should now be filled with the vapor of menthol-chloroform and *used with no more force* than is necessary to free the tube and middle ear from mucus. This treatment should be repeated once or twice a day, omitting the use of the cocain and antipyrin if the nasopharyngeal mucous membrane be not sufficiently swollen to require it.

If, notwithstanding antiphlogistic and other measures, there is bulging of the tympanic membrane, with indications that a perforation is likely to occur, it should be *punctured* by a paracentesis needle at the most prominent point of bulg-

ing or in the posterior inferior quadrant. This operation is harmless if antiseptic precautions be observed. The canal should be cleansed by wiping it out with a pledget of cotton wrapped about an Allen probe saturated with peroxid of hydrogen. It should then be syringed gently with warm corrosive sublimate solution (1 : 2000). After being sterilized a knife (Fig. 229, *e* or *f*) should be thrust through the membrane. If the malleus handle is not invisible as the result of swelling, the operator should make the puncture on a level with the tip of the malleus handle and midway between it and the periphary of the drum-head, and cut downward as far as possible while the knife is being withdrawn. If this technic is observed it will tend to avoid puncturing the bulb of the jugular vein, which in some cases lies immediately beneath the mucous membrane of the floor of the tympanum, without an intervening lamina of bone. Should the vein accidentally be punctured the hemorrhage for a moment may be quite free, but is readily controlled by packing the canal with iodoform gauze.

Puncturing a normal drum-head after the parts have been cocainized is not a very painful procedure, but when inflamed, paracentesis causes severe pain even after the fundus of the canal has been soaked in a 4 per cent. solution of cocain for ten or fifteen minutes. Therefore, if the operation is performed without a general anesthetic, it should be done with the utmost quickness. The thrusting of the knife through the drum-head is sometimes followed by the escape of air with an audible hiss. At other times there is an escape of fluid which quickly fills the entire canal, but in some cases there is little fluid secreted for some hours after the operation. The canal in either case should be stopped with a loose plug of sterile iodoform gauze, which should be changed as often as it becomes saturated by secretions.

The relief from pain occurs in some cases within a few moments after the operation. In other cases an hour or more elapses before the pain begins to subside. There are but few if any cases where no relief from pain is afforded by the operation.

Otitis Media Catarrhalis Subacuta.—The name is sometimes applied to that stage of catarrhal disease intermediate

between the acute and chronic forms. However, by *subacute* catarrh of the middle ear or simple acute otitis media is generally meant an inflammation less severe in type than the acute. Pain is neither severe nor long continued and the patient is deaf only for a short time. The attacks occur at frequent intervals. Upon examination the membrana tympani is found pinkish in color and is decidedly opaque and lacks its usual lustre. The cone of light is either smaller than normal or has entirely disappeared. As the drumhead never ruptures, permitting an examination of exudates, the kind of bacteria present is a matter of conjecture. It is doubtful if any be present, as, according to Hassleur and Preysing, no bacteria are present in the normal middle ear.

Etiology.—The disease is commonest in children as the result of disease of the nose and pharynx, hypertrophied pharyngeal tonsil being an exceedingly common cause of the affection. Bad nutrition, carious teeth, and frequent attacks of coryza are common predisposing causes.

The *treatment* should be directed toward improving the patient's general health and removing any predisposing cause of the affection. If the teeth are carious they should receive the attention of a skilful dentist, while the efforts of the aurist should be carefully directed toward the removal of any morbid condition existing in the nose and nasopharynx, because experience has amply demonstrated that in most cases attacks of subacute aural catarrh cease to recur as soon as a cure is brought about of the concomitant nasopharyngeal disease. The knowledge of this fact, however, is not an excuse for neglecting local treatment of the ears while the nose and nasopharynx are receiving attention.

Adenoid growths and hypertrophied faucial tonsils should be reduced in size, the former by means of Gottstein's curet and the latter by the tonsillotome or by ignipuncture in the manner already described.

At each biweekly or triweekly visit of the patient the nose and nasopharynx should be cleansed by means of an atomizer filled with an alkaline antiseptic wash (Formula 1 or 2), after which the ears should be carefully inflated by means of Politzer's air-bag. If the inflammation of the middle ear is not too active, "massage" should be applied to the drum-

head and the ossicles by the aid of Siegle's pneumatic speculum, after which there should be made to the interior of the nose and nasopharynx an application of an iodin solution (Formula 33) in the case of children, or an astringent solution (Formulas 34, 35) in the case of adults, and the parts covered with albolene by means of the spray from an atomizer.

The *hygienic surroundings* of the patient should receive careful attention and tonics and cod-liver oil prescribed in suitable cases. In children catarrhal inflammation is generally of an adenoid character; that is, the lymphatic elements of the mucous membrane bear the brunt of the disease, so that children and young adults do well upon iodin compounds applied locally and given internally. Syrup of the iodid of iron should be prescribed for internal use, with or without cod-liver oil, as the circumstances of the case require, while hypertrophy of the lymphatic glands underneath the skin of the neck should be treated by inunctions at bedtime of a 10 per cent. ointment of ichthyol in lanolin. The ointment should be rubbed lightly into the skin and the bedclothing protected by waxed paper and a bandage about the child's neck.

Catarrh in adults is often characterized by inflammation of the mucous glands and interstitial elements of the mucous membrane; and it is in such cases that sedative applications and astringents are most useful. The vapors of various volatile substances are sometimes applied to the middle ear by means of Politzer's air-bag. The most useful of these substances are iodin, menthol, and chloroform. Glass-stoppered bottles, each partly filled with one of these drugs (Formulas 90–93), should be at hand in the office, so that the Politzer air-bag can readily be filled with the vapor of the drug which it is desired to use by inserting the nose-piece of the instrument within the neck of the bottle. The vapor can then be made to reach the mucous membrane of the middle ear by Politzer's method or by the employment of a Eustachian catheter. The vapor of iodin, when thrown into the middle ear, acts as an alterative and gentle stimulant, that of menthol as a sedative, while chloroform vapor is probably simply a stimulant. It is generally

easier to inflate the middle ear when the air-bag is filled with chloroform vapor than when it contains simply air.

Otitis Media Catarrhalis Chronica.—Chronic catarrh of the middle ear is a chronic non-suppurative inflammation of the mucous membrane and submucous tissues of the middle ear, producing deafness, tinnitus, and sometimes vertigo and other symptoms of altered auditory functions.

There are two varieties of the disease—the *hyperplastic* and the *atrophic*—which are simply stages of the same disease.

Synonyms.—According to its stage, the disease is sometimes known as moist and dry catarrh, hypertrophic and atrophic, catarrhal, and proliferous inflammation of the middle ear.

Pathology.—Gradual progressive changes take place in the mucous membrane and submucous tissues of the middle ear, similar in character to those that occur in the mucous membranes of other parts of the body, and analogous to cirrhosis of the liver, kidneys, or lungs and sclerosis of the brain and spinal cord. There is first hyperemia and hypertrophy, then hyperplasia and, finally, sclerosis.

The first stage of the disease is a dilatation and engorgement of the capillaries, with an exudation of serum and round cells, both from the surface of the mucous membrane and also into its substance. The capillaries are engorged, the mucous membrane is swollen and edematous; an exudate is constantly moistening its surface. The inflammatory exudate within the substance of the mucous membrane contains rounds cells, which proliferate and increase in size by a process of elongation, so that they are finally converted into newly formed connective tissue, sometimes causing cords, bands, and membranes similar in appearance to cicatricial tissue following suppuration.

During the earlier stages of the disease the thickened mucous membrane is redder and rougher than normal, soft, and easily depressed with the end of a probe. As a result, however, of the gradual increase of connective tissue and the absorption of the more fluid parts of the exudate, the mucous membrane, while still much thicker than normal, is pale and quite smooth. This condition represents a stage intermediate between hypertrophy and atrophy of the tym-

panic mucous membrane. It is hyperplasia of the mucous membrane.

As a mechanical result of the contraction of the newly formed connective tissue the glandular elements of the mucous membrane disappear and it finally resembles *scar-tissue*. The mucous membrane becomes smooth, thin, and secretes but little fluid. In some cases atrophy or sclerosis of the mucous membrane of the tympanum rapidly occurs without any pre-existing stages of hypertophy. Such cases are often the result of syphilis or they follow purulent inflammation of the mucous membrane with or without perforation of the drum-head.

It should not be supposed that the changes in structure above described progress evenly throughout the entire mucous membrane. Often depressed, scar-like spots of atrophy are seen in the midst of the rough, succulent, and swollen mucous membrane characteristic of the hypertrophic stage of chronic aural catarrh.

Not only are the mucous and submucous structures involved in long-continued catarrh of the middle ear, but the bony structures are affected as well and, ultimately, the labyrinth also. The cavity of the tympanum becomes more roomy, and as a result of interference with the nutrition of the parts chalk deposits take place in the deeper layers of the mucous membrane close to the bone, in the membrana tympani, the membrane of the round and oval windows, and in the ligaments and cartilages connected with the ossicles. The ossicles frequently become ankylosed, and adhesions form which bind them to one another or to the surrounding bony walls of the tympanum, while bands of newly formed connective tissue may extend across the tympanum or mastoid antrum. The membrana tympani and manubrium sometimes become adherent to the promontory (Fig. 221).

FIG. 221.—Schematic section of a case of attachment of the manubrium to the promontory (Politzer).

Ordinarily, catarrh of the middle ear is but part of a diseased process involving the nose, throat, Eustachian tubes, and mastoid cells. The stage of the disease and the

degree of inflammation may vary in the different parts affected. In most instances the Eustachian tube is the first part of the middle ear affected. In some instances the disease progresses by continuity of structure from the pharyngeal mouths of the Eustachian tube into the tympanum; while in others stenosis of the tube, from swelling of the lining mucous membrane or accumulation of secretions, interferes with the proper ventilation of the tympanum, thus producing a partial vacuum within the cavity, a constant *dry cupping*, as it were, of the tympanic mucous membrane, with consequent engorgement of its capillaries.

Etiology.—It is generally the result of an extension of a similar disease of the nasopharynx through the Eustachian tubes. The chronic condition may become established after repeated attacks of acute catarrhal inflammation of the middle ear. Carious teeth cause chronic catarrh of the middle ear as the result of reflex irritation. Syphilis sometimes causes chronic catarrh of the middle ear, but more often suppuration occurs as the result of diphtheria, measles, scarlatina, or typhoid fever. Those constantly exposed to loud noises as the result of working at certain trades, like boiler-making, are especially prone to lose their hearing. Syphilis, scrofula, and any condition of lowered vitality, inherited or acquired, may be enumerated as predisposing causes of the disease.

Subjective Symptoms.—There is gradually increasing deafness. The decrease in the power of hearing is, however, by no means uniform. Successive attacks of subacute exacerbations of the catarrhal inflammation produce comparatively great impairment of the hearing power, which in turn somewhat improves. In this manner the disease progresses, the hearing being better or worse from week to week, but becoming gradually less impaired from year to year. Many patients hear better during clear, dry weather than on rainy or damp days. This is not the result of any change in the acuteness of hearing, but due simply to the fact that dry, cold air is a better conductor of sound than moist air. The acuteness of hearing may not decrease to the same degree for all sounds. Many patients hear a watch tick at almost the normal distance, but hear spoken words very indistinctly.

In other cases the impairment of hearing is most manifest for musical tones, like those emitted by a tuning-fork. A common remark from some patients is that they hear the sound of the voice distinctly, but are unable to distinguish the words spoken. This *slow* hearing is probably due to the sluggish action of the tensor tympani and stapedius muscles, whose action changes the tension of the ossicular chain, so that under normal conditions it is instantly tuned to the pitch of each sound. Hence most deaf persons hear words best not when spoken in a loud voice, but when spoken slowly and distinctly.

A sense of fulness and discomfort within the ear and certain modifications of the hearing are not uncommon during the course of chronic aural catarrh, the commonest modification of the hearing power being *paracusis Willisii* or increased hearing power in the midst of noise, as, for example, when the patient is on a moving railroad train. This phenomenon has been ascribed to great rigidity of the ossicles and contraction of the tensor tympani muscle, and it is of sinister import as to the ultimate effects of treatment.

Dysacousma or *dysesthesia acoustica* is a condition in which loud noises or even those of moderate intensity cause painful sensations. When the patient hears his own voice, somewhat altered in character and pitch, as if it came from a distance or through the tissues of his head, the symptom is called *autophony*. *Paracusis duplicata* and *paracusis diplocusis* are names given to the phenomenon in which the patient hears sounds as if repeated twice, the second sound seeming somewhat like an echo of the first. Probably in most cases of chronic catarrhal deafness sounds are not only altered in intensity but also in pitch and character as well. It is difficult, however, to observe any subjective alteration in the character or pitch of musical notes, except in the case of musicians who are deaf only in one ear. In such cases not infrequently the note of a tuning-fork will seem to be of a different character and pitch when sounded before the deaf ear from that emitted by the same fork when sounded before the patient's normal ear. When subjective alteration of the character and pitch of sounds is sufficiently

manifest to be a source of discomfort to the patient the name *pseudacousma*, or false hearing, is applied.

Tinnitus, subjective ringing or hissing sounds heard in the ear, is a symptom of aural catarrh rivalling in importance even progressive hardness of hearing. It is sometimes the only symptom of which the patient complains, the fact being that, although he is somewhat deaf, yet his hearing is still sufficiently acute for the ordinary purposes of his life and occasions no discomfort. Some such patients are actually surprised when tests of their hearing demonstrate that it is defective. This is especially the case when only one ear is diseased. Tinnitus is usually worse at night and it may not be present at all in some cases during the daytime. It is subject to great variations in degree in some cases of aural catarrh, disappearing for months at a time and then reappearing. Usually tinnitus disappears in the later stages of the disease. Involvement of the labyrinth may increase or decrease tinnitus, according as the nerve-fibers are simply irritated or destroyed.

Vertigo is a symptom of chronic otitis media, usually transitory in character. In all cases it is probable that aural vertigo is due to some condition within the semicircular canals of the labyrinth: generally it is an alteration of the normal interlabyrinthine pressure produced by increased tension exerted through the fenestræ or by a contracted tensor tympani through a rigid chain of ankylosed ossicles. Only when *structural changes* have occurred to the tissues within the labyrinth should the name "Ménière's disease" be given to a condition which otherwise is simply aural vertigo and one of the symptoms of disease of the middle ear.

The most important *objective symptoms* are those revealed by inspection of the membrana tympani, ascertaining the condition of the Eustachian tubes, and testing the hearing by means of the voice, the watch, and tuning-forks.

Although the condition of the membrane is not invariably an index of the condition of the tympanum, yet certain inferences may be drawn from its appearance that are the more valuable because it is the only visible part of the tympanum. The lustre and color of the drum-head may be nearly normal both at the commencement of chronic otitis

media and also at a stage of the disease when the atrophic changes are not far advanced. In the latter condition, however, the membrane is generally abnormally translucent, so that a red reflex from the promontory is discernible, and also the outlines of the descending process of the incus and the incudostapedial articulation. During the hypertrophic period of catarrh of the middle ear evidences of involvement of the drum-head are usually not lacking. There may be patches of opacity or the whole drum-head may have lost its translucency and appear white, rough, thick, and opaque. The light spot may not occupy its normal position as the result of an indrawing of the drum-head or it may be smaller than normal because of a roughening of its surface, and from the same cause or from local depressions it may divide into two or more maculæ. If the drum-head is greatly depressed a light spot sometimes appears over the short process, which projects outward through the tightly drawn tissues like the knuckle of a finger. The handle of the malleus is, under such circumstances, foreshortened, appears shorter than normal, or it may be drawn so far backward as to lie almost horizontal beneath the posterior fold. Spaces abnormally white and opaque may be interspersed upon the same membrane with spots abnormally thin and translucent.

It is always a matter of considerable importance to determine the resiliency and tension of the membrane. This may be effected by observing the movements of the drum through Siegle's pneumatic speculum (Fig. 31) during rarefaction and compression of the air within the auditory canal. When the air within the canal is rarefied by means of this instrument a drum-head so far indrawn that it rests upon the promontory may be sucked outward until it appears like a balloon, a groove upon its convex surface indicating the position of the malleus handle. Sometimes isolated areas upon the drum-head will exhibit abnormal mobility. Ordinarily such spots are cicatrices formed by the closure of a perforation. This appearance may be produced, however, by localized atrophy.

Deep localized depressions are found at spots where adhesions have occurred between the membrane and promon-

tory (Fig. 222), such spots appearing much darker than the surrounding area. Sharply defined deposits of chalk, more especially in the posterior half of the drum-head, are not uncommonly seen (Fig. 218).

The *patency of the Eustachian tube* is tested by the Politzer method of inflation. During the earlier stages of the disease the tubes are usually somewhat obstructed, but during the later stage they are abnormally patulous. A favorable prognosis may be given the patient if after inflation of the tympanum the hearing is greatly improved. Under such circumstances the impairment of hearing is largely due to obstruction of the Eustachian tubes—a condition amenable to treatment. If, however, the tympanum is easily inflated by the Politzer method and there results

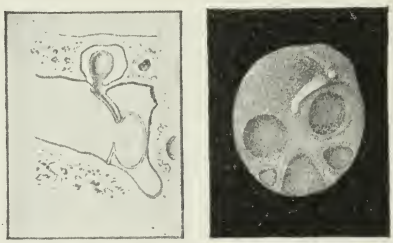


FIG. 222.—Residua of middle-ear suppuration. Transverse section (schematic), showing adhesions of drum-head to promontory. Front view, showing old cicatricial center lesions (Spalding).

considerable outward movement of the membrana tympani without much improvement in the hearing, the prospect of speedily improving the acuteness of hearing without operative interference is not encouraging.

In the hyperemic and hypertrophic stages of catarrhal deafness hearing for the voice is usually proportionately better than for the watch and tuning-fork; in the atrophic form of the disease, however, the reverse is usually the case. If only one ear be affected, a vibrating tuning-fork placed on the vertex, forehead, or teeth (Weber's method) is heard best in the affected ear so long as the functions of the auditory nerve and labyrinth are unimpaired. When, however, serious involvement of the labyrinth has occurred, tissue-conduction, as tested by Weber's method, will be found

greatly diminished or even abrogated upon the affected side. Before involvement of the receptive apparatus has occurred a vibrating tuning-fork with its handle upon the mastoid will be heard better than when its vibrating tines are held in front of the ear (Rinne negative). Rinne's test is positive when the labyrinth is seriously involved, and under such circumstances hearing both by tissue and aërial conduction is more greatly impaired for the higher notes of the musical scale than for the lower notes.

The *prognosis* is only favorable in cases in which the disease has not progressed beyond the early hypertrophic stage of the disease. Fluid exudates will be absorbed as the result of treatment and simple inflammation of the mucous membrane of the tympanum will disappear. The prognosis is all the more favorable if the disease is the result of pathologic conditions within the nose or nasopharynx, because in such cases, when the nose and throat are restored to a nearly normal condition, chronic aural catarrh of recent origin usually subsides as the result of appropriate local treatment. The progress of the disease can, in most instances, be delayed, but when new connective tissue has formed it remains and atrophied parts cannot be regenerated. The prognosis is generally hopeless, so far as improvement of the hearing is concerned, in cases in which the labyrinth is seriously involved. However, this may be said for the comfort of those to whom an unfavorable prognosis is given: Chronic middle-ear catarrh is, to a considerable extent, a self-limited disease that progresses irregularly and with greater or less rapidity to a certain degree of deafness, after which the progress is slow. None become completely deaf.

Treatment.—An effort should be made to improve the hygienic surroundings of the patient and to so improve his general health as to render him less liable to contract colds. The nose and throat, if necessary, should receive appropriate treatment. Hypertrophies, ecchondroses, and exostoses of the nasal chambers and adenoid vegetations in the pharyngeal vault should be removed; hypertrophied faucial tonsils should be reduced to their normal dimensions. While the immediate effect of any measure to secure free nasal

respiration may not be apparent in improved hearing, the freedom from frequent stenosis of the nares from colds and consequent irritation of the middle ear will, after a month or two, scarcely fail to attract the patient's attention.

Triweekly or even daily inflation of the Eustachian tubes is of great importance. For this purpose Politzer's method, when possible, should be employed in hypertrophic cases. In atrophic cases, however, the irritation produced by the introduction of the Eustachian catheter is sometimes of marked benefit. Either simple air or air saturated with the vapor of chloroform, iodin, menthol, or turpentine may be used for producing the inflation (Formulas 90–93).

In cases where the labyrinth is involved Politzer's method of inflation should be used with extreme gentleness if at all. Ordinarily in atrophic cases the Eustachian tubes are widely dilated, and the violent use of Politzer's bag causes a most unpleasant sensation to the patient and an immediate decrease in the hearing power, which gradually grows worse from repetition of the treatment.

Many cases of atrophy not too far advanced are greatly benefited by a spray of menthol and camphor in fluid albolene (Formula 17), thrown into the middle ear by means of the Eustachian catheter and atomizer. After introducing the catheter and applying the auscultation-tube the patulency of the Eustachian tube is tested by means of Politzer's bag (Fig. 187). The nozzle of an atomizer then is inserted within the proximal extremity of the catheter. In cases where the Eustachian tube is widely dilated the spray from the atomizer will be heard to enter the tympanum; but in most instances it enters the Eustachian tube for but a short distance except during the act of swallowing by the patient. After a time a certain amount of oil condenses in the catheter and Eustachian tube. This should be blown as far up the tube as possible by means of Politzer's bag.

It is convenient to use an air receiver to work the atomizer in order to secure steadiness of its tip when inserted into the catheter, but with a little care an ordinary hand atomizer may be employed without inconvenience to the patient. It is doubtful if a large amount of the oil actually enters the tympanum in the majority of instances, and an excessive

quantity if present would be removed when Politzerization is employed after the use of the atomizer, and hence the method is entirely free from danger. When the Eustachian tube is contracted the oil seems in some instances to act like a Eustachian bougie and secures dilatation.

Stricture of the Eustachian tube may be dilated by carefully passing a Eustachian bougie through the stricture, but the use of this instrument requires the utmost care to avoid a disastrous or even fatal result from emphysema as the result of tearing the tubal mucous membrane.

The *diagnosis* of stricture of the tube is made by means of the catheter and auscultation-tube. Air is not heard to enter the tympanum. This may be due to simple swelling of the mucous membrane, transient in character, which can be made to yield by blowing a drop or two of a 4 per cent. cocain solution from the catheter into the tube, followed in a few moments by an oily spray of adrenalin (1 : 1000) through the catheter. If after a few moments air is heard to enter the middle ear through the catheter, the Eustachian tube may be sprayed with menthol-camphor-albolene in the manner previously described.

If, however, these measures fail to secure the entrance of air into the middle ear, employment of the Eustachian bougie is a justifiable procedure. As long as no stricture is encountered the bougie can be passed somewhat readily from the catheter along the Eustachian tube. If resistance is felt it may be due to the normal narrowing of the tube at the isthmus. The bougie should be marked in millimeters in such a manner that it is possible, by referring to these markings, to know the exact position of the distal end of the bougie and when it has entered the isthmus or junction of the cartilaginous and bony portions of the tube. It is not desirable to push the bougie much beyond this portion of the tube.

If a stricture is encountered a resistance will be felt to the onward passage of the bougie, which usually can be overcome by gentle pressure for a few moments. After the bougie has passed beyond the stricture it should be allowed to remain in position for a few minutes and then withdrawn. When it is impossible to pass a bougie of hard rubber or

whalebone, an attempt may be made to destroy the stricture by electrolysis. Duel has devised gold bougies of three sizes for this purpose, one of which is passed through a rubber-covered catheter into the tube until the stricture is encountered. The sponge from the positive pole of the battery is applied to the patient's neck and the negative pole is connected with the bougie. The current is then gently turned on to a strength not exceeding 3 to 5 milliampères. The bougie is held firmly in contact with the stricture and after a moment is felt to pass through it.

The *treatment* causes no pain and may be repeated at intervals of once a week. It is safer not to attempt to inflate the middle ear immediately after the passage of a bougie. The patient, however, may return the next day to have his ears inflated.

The bougie may be passed into the Eustachian tube after the passage has been oiled with the spray from an atomizer containing albolene or a few drops of a 50 per cent. solution of argyrol may be dropped into the catheter before passing a hard-rubber bougie through it into the tube.

Massage of the Middle Ear.—Next in importance to inflation of the middle ear is systematic massage by means of Siegle's pneumatic speculum or some other massage instrument (Figs. 31–33), by means of which the air within the auditory canal can alternately be rapidly condensed and rarefied, and motion be thus imparted to the membrana tympani and ossicles. This procedure is almost invariably followed by an amelioration of tinnitus if this symptom be present, and it probably constitutes the most satisfactory treatment for this annoying symptom, although freezing the tissues over the mastoid process by means of the spray from a tube of ethyl chlorid and exhausting the air within the auditory canal by a plug of oiled absorbent cotton sometimes yield good results.

Systematic massage of the middle ear by means of the patient's finger-tips is of the greatest value, for while it is somewhat dangerous to instruct an individual to inflate his middle ears by Valsalva's method, as its frequent use is liable to be followed by atrophy of the drum-head and increased deafness, automassage with the finger-tips is

entirely harmless and may be used for the relief of tinnitus whenever it becomes annoying. The forefinger should be slightly moistened and slipped into the meatus with the nail posterior. With rapid piston-like movements of the finger-tip inward and outward a patient can easily exercise alternations of pressure and rarefaction of the air within the auditory canal, and hence massage the intratympanum almost as thoroughly as if a pneumatic speculum were used. He may be instructed to employ the method several times a day with increasing relief of tinnitus in many instances and, generally, improvement of the acuteness of hearing. It is seldom that the method fails to afford at least temporary relief from the feeling of fulness or pressure within the ear.

Phonomassage, by means of sounds conveyed to the ear through rubber tubes from various musical instruments or similar contrivances, has been employed in the treatment of catarrhal deafness and tinnitus. If the ears of an individual with catarrhal deafness be subjected for a length of time to musical tones of about the same pitch as the tinnitus from which he suffers, the subjective noises will either entirely disappear or be greatly alleviated, probably as the result of fatigue of the portion of the internal ear adapted for the perception of sounds of that pitch. This method of treatment has been largely abandoned in favor of more rational methods.

Pneumomassage with electromagnetic and other machines (Fig. 33) capable of producing rapid alternate rarefaction and condensation of the air in the auditory canal is undoubtedly of benefit in a large proportion of chronic middle-ear catarrhs, but is probably in no way superior to massage with the pneumatic speculum or the tip of the forefinger. The same remark also applies to direct massage of the chain of ossicles by means of Lucca's pressure probe, which is a spring probe, the cup-shaped end of which fits over the short process of the malleus to prevent slipping; and also to the so-called "internal massage," where short, sharp puffs of compressed air from an air-receiver are, by means of an "automatic cut-off" (Fig. 42), rapidly worked with the tip of the thumb, thrown through a catheter into the Eustachian tube.

The wedging of a little ball of absorbent cotton into the space above the short process of the malleus, where its weight and pressure serve constantly to push outward the malleus handle and the long process of the incus, thus diminishing pressure on the stapes, in a certain number of cases will afford efficient aid in the treatment of tinnitus and hardness of hearing. The little mass of cotton should be moistened with a suitable antiseptic solution, so that it can be molded to the parts when inserted above the malleus handle, and may with benefit in certain cases be worn for several weeks at a time. It is not readily dislodged from its position by massage either with the pneumatic speculum or the finger-tip, and sometimes gives immediate and ultimately permanent relief from tinnitus.

Tension of the transmitting apparatus of the middle ear may also be decreased by operative procedures, such as repeated paracenteses of the drum-head, tenotomy of the tensor tympani and stapedius, or removal of the membrana tympani and one or more of the ossicles.

The *head noises* complained of by patients are almost as numerous as the individuals affected, but may be divided into three classes—the pulsating, the continuous, and sounds more or less elaborated, like the ringing of bells, music, and words and sentences uttered with more or less distinctness —the latter class only being referred to a point outside the head.

Tinnitus is more often pulsating than patients are willing to admit until the fact is demonstrated to them by placing the hand upon their pulse and beating time to it with a finger. Sometimes the result of anemia or, more rarely, of an aneurysm, pulsating tinnitus ordinarily indicates arterial congestion of the middle ear or of the labyrinth. The differential diagnosis between the two conditions can be made with a limited amount of accuracy by pressure upon the carotids or on the vertebral arteries at the point where they cross the atlas, because a branch of the carotid supplies the tympanum and a branch of the vertebral supplies the labyrinth.

The faint pulsating tinnitus due to anemia is diminished by the patient's lying down, and in many instances can be

permanently cured by hygienic measures and suitable tonics, among which the well-known pil. sumbul comp. is especially useful. Pulsating tinnitus due to congestion, on the other hand, may be alleviated by the bromids, of which, for a reason that will appear below, dilute hydrobromic acid, in doses of from 15 to 60 drops three times a day, is probably the best.

The earlier stage of chronic catarrh of the middle ear is ordinarily accompanied by tinnitus, generally constant in character. Later on, as deafness becomes profound, tinnitus often disappears as the result of diminished sensibility of the internal ear. Tinnitus due to middle-ear catarrh is sometimes alleviated by large doses of the bromids; but better results can be obtained in a limited number of cases by the patient taking after meals, for a few weeks, a pill containing $\frac{1}{4}$ gr. of nitrate of silver, $\frac{1}{3}$ gr. of extract of hyoscyamus, and $\frac{1}{30}$ gr. of strychnin.

Inflammation of the external auditory canal, foreign bodies, impacted cerumen, and polypus are capable of producing tinnitus and, in rare cases, vertigo, nausea, cough, or even epileptiform convulsions.

Not always is tinnitus the result of diseases of the ear, but rather is a reflex phenomenon due to the irritation of some correlated region—the nose, teeth, or, more frequently, the digestive tract. Just as acute dyspepsia is ordinarily accompanied by vertigo, so the more chronic ailments of the digestive tract sometimes occasion a tinnitus the cause of which is little suspected. The manner in which disease of the digestive tract, teeth, or nose produces tinnitus is, as pointed out by Woakes, through the nervous connection, more or less direct, of these organs with the inferior cervical sympathetic ganglion, which supplies the nervi vasorum to the occipital artery and its branch, the internal auricular. Irritation of the inferior cervical sympathetic ganglion would cause tinnitus as the result of dilation of the arterioles of the cochlea, which, at first pulsating, would afterward become constant in character as the result of trophic changes resulting from increased blood supply. Quinin, the salicylates, and certain other drugs are capable of producing tinnitus, either as the result of aural hyperemia

or by their toxic action upon the internal ear. There is also reason to suppose that in lithemia the products of indigestion exert a similar action in the production of tinnitus. It is, therefore, in cases where dyspepsia and lithemia have done their share in the production of tinnitus that acids, including hydrobromic acid, are especially useful in controlling this annoying symptom. Proper regulation of the diet and regular exercise in the open air and sunlight will, in cases where there is neither disease of the ear, nose, nor teeth to account for tinnitus, generally result in a disappearance of the head noises.

The more elaborate subjective sounds, heard as if produced outside the body—such as the ringing of bells and spoken sentences—are the result of disease of the ear acting on an easily excited brain. Some of the cases are at least on the border-line of insanity, and not only hear voices but see visions, either religious or otherwise in character. Benefit sometimes results from treating the concomitant aural disease.

Otitis Media Suppurativa Acuta.—Acute purulent inflammation of the middle ear is an acute purulent inflammation of the mucous membrane of the tympanum, and usually also of that of the Eustachian tube and mastoid cells.

Pathology.—The tympanic mucous membrane is of a bright red color, much swollen, and devoid of its epithelium. There is cellular and serous infiltration of its connective-tissue layer and much exudation of mucopus or pus from its surface. Perforation of the membrana tympani occurs in the majority of cases, the pus being then discharged through the perforation into the auditory meatus; occasionally the discharge is tinged with blood.

Etiology.—Generally the disease is the result of a cold or of traumatism, or it may occur as a complication during diphtheria, scarlatina, small-pox, measles, typhoid fever, syphilis, or tuberculosis. Purulent inflammation of the middle ear is very common in children. Carious teeth and nasopharyngeal disease are predisposing causes of the affection. Suppuration presupposes bacterial infection, which probably takes place in most instances by way of the pharynx and Eustachian tube. It is a general rule that the

infection at first at least is monobacterial, but that after the membrana is ruptured polybacterial infection commonly occurs from the canal. Efforts should, of course, be directed to prevent if posssible this mixed infection. The microorganisms most commonly found in otorrheal pus are streptococcus pyogenes, pneumococcus, staphylococcus aureus and albus, typhoid and tubercle bacilli. Of the monobacterial infections, that of the streptococcus is most likely to run a severe course, possibly ending in severe mastoid complications.

Symptoms.—An attack is ushered in by pain in the ear, shooting over the side of the head. Sometimes the pain originates in a diseased tooth and extends to the ear. Chilly sensations and fever are sometimes present, the temperature reaching as high as 102° or 103° F. The ear feels full and there are tinnitus and deafness, the pressure of confined pus upon the secondary membrane sometimes interfering with the functions of the labyrinth. When perforation takes place there occurs a rapid alleviation of the pain and tinnitus.

The appearance of the drum-head is that of acute myringitis. At the end of a few hours to several days or even weeks from the beginning of the attack a bulging at some point upon the drum-head indicates the position where the pus will burrow its way through the membrana. When, however, the attic and mastoid antrum contain pus which cannot readily drain into the atrium because of swelling of the mucous membrane about the ossicles, this pus will sometimes burrow underneath the skin of the auditory canal and find an exit either at some point within the canal or behind the auricle. Those cases in which no perforation occurs run a tedious course and some permanent impairment of the hearing usually ensues. The duration of the disease from the occurrence of a perforation to its closure is very variable. In cases where the perforation occurs early it may remain open only for a few days. Three or four weeks are ordinarily required for the closure of a small perforation.

If the perforation is large it will probably remain open long after suppuration has ceased, to finally close by cicatricial material destitute of all fibers of the membrana propria,

and will bulge inward and outward with the varying intertympanic pressure.

Extensive destruction of the structures of the middle ear sometimes occurs during acute otitis media. This is especially apt to take place when the disease appears as a complication of scarlatina, variola, or diphtheria. The whole of the drum-membrane and all of the ossicles may come away within a few days from the onset of the middle-ear disease as an enormous slough. In other cases ulceration, starting from the perforation, proceeds more slowly, but it accomplishes equally disastrous results. Inflammation of the mastoid is occasionally a serious complication of acute otitis media, and the labyrinth sometimes participates in the purulent inflammation of the tympanic cavity, the ultimate result in such cases being intracranial complications, often fatal.

Infants affected by acute suppuration cry constantly, turning their heads restlessly from side to side, placing the hand frequently upon the affected ear. High temperature, reaching 103° or 104° F., is usually present and convulsions sometimes occur. The infant sleeps only when completely exhausted or under the influence of opiates. Upon inspection the drum-head is often found enormously swollen, projecting into the canal like a polypus, for which it has been mistaken. Sleeplessness, high temperature, and restlessness quickly disappear after evacuation of the pus.

The *prognosis* of acute purulent inflammation of the middle ear, when it occurs in an otherwise healthy individual, is usually favorable, but the severity of the attack depends largely on the variety of bacteria causing the infection and their virulence. However, the disease frequently assumes the chronic form, and in tuberculous individuals this is the usual outcome of the affection.

Treatment.—In the early stages of the disease leeches, hot applications, and the other measures for the relief of pain already specified are useful for the relief of pain in catarrhal inflammation of the middle ear. Paracentesis of the membrane should be done as soon as bulging occurs. The cut should be 2 or 3 millimeters long and should be made through the point at which the bulging occurs or at the so-

called point of election in the posterior quadrant of the membrana tympani, midway between the malleus handle and the periphery (see p. 379). When there is considerable swelling of the upper posterior part of the auditory canal, indicating the presence of pus beneath the skin of this region, the thrust should be through Shrapnell's membrane, and the knife be so withdrawn that its point will cut through the swollen tissues at the upper posterior portion of the canal to the bone, in order to secure free drainage.

After incision of the drum-membrane or when rupture has occurred spontaneously the major part of the pus within the auditory canal should daily be removed by means of absorbent cotton wrapped about the end of a probe, and the pus within the tympanum expelled through the opening in the drum-head by the Politzer method of inflation. After

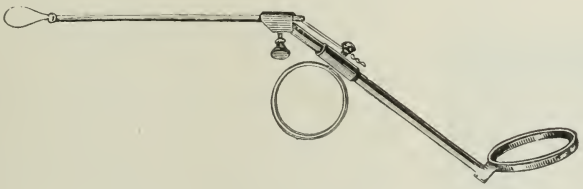


FIG. 223.—Blake's polypus snare.

this has been accomplished the auditory canal should be cleansed thoroughly by means of a cotton-tipped probe wet with a 15-volume solution of peroxid of hydrogen, the parts thoroughly dried, and covered with powdered boric acid by means of the powder-blower.

If exuberant granulations sufficiently large to obstruct free drainage from the tympanum occur, they should be removed by means of a snare (Fig. 223), by Hartmann's forceps (Fig. 205), or by touching them with *chromic acid* fused on the end of a probe. Considerable caution is required in the use of chromic acid. The granulations or small polypi should first be dried thoroughly by means of absorbent cotton, in order to prevent the acid dissolving and flowing over adjacent structures. No more of the acid should be applied than is necessary to accomplish the desired result, and any excess remaining within the canal should be neutralized by

syringing with a warm alkaline solution. Small polypi and exuberant granulations are most apt to occur and obstruct drainage when the pus has found its way through an opening in Shrapnell's membrane at a point on the upper and posterior part of the auditory canal.

Otitis Media Suppurativa Chronica.—*Etiology.*—Chronic purulent inflammation of the middle ear is generally caused by neglect or improper treatment of acute purulent disease of the middle ear and the failure to secure adequate drainage. Adenoids, nasopharyngeal disease, and malnutrition prevent sometimes a prompt secession of an otorrhea. The affection may, however, develop primarily as the result of syphilis or tuberculosis. Numerous cases are the result of scarlatina.

Symptoms.—There is a mucopurulent or purulent discharge, sometimes tinged with blood. The acuteness of hearing varies according to the amount of destruction of the structures of the middle ear or to the presence of polypi or semi-inspissated secretions blocking the canal or interfering with the functions of the ossicles. In some instances the hearing is nearly normal, while in others deafness is nearly absolute. Tinnitus may or may not be present.

FIG. 224.—Residua of middle-ear suppuration. Nearly total loss of the drum-head. Handle of hammer resting on mucosa of promontory (Spalding).

The presence of a discharge in the auditory canal from the middle ear presupposes the presence of a perforation of the drum-head. The perforation, on the one hand, may be so minute as to escape observation by otoscopy, its presence being only revealed by a "perforation whistle" during inflation of the ear either by Politzer's or Valsalva's method. On the other hand, the destruction of the drum-head may be so extensive as to expose the cavity of the tympanum to view and reveal all of the structures of the inner wall (Fig. 224). In some cases the remains of the drum-head may be represented only by a narrow ring; in other cases the ossicles may have also disappeared, either from ulceration and sloughing of their ligaments or by necrosis of the bones themselves. Necrosis of

some portions of the tympanic walls may also exist. To a considerable extent the position and size of the perforation will indicate the position and extent of the necrotic process (Fig. 225). The appearance of the tympanic mucous membrane varies somewhat. In one class of cases it is simply red and swollen, while in another class it appears granular and polypi may be present, perhaps covering the orifice of a sinus leading to exposed bone.

Politzer states that usually there is a destruction of the ciliated epithelium and a thickening of the mucous membrane from infiltration of round cells with a dilatation and

FIG. 225.—1–5, Simple suppurations of the drum-cavity and the Eustachian tube; 6–8, caries of the incus; 7, caries of the head of the malleus; 9, attic suppuration with possible caries of both malleus and incus; 10, 11, caries of the head of the malleus; 12, caries of the incus and suppuration of the antrum, and, possibly, associated cholesteatoma. (Leutert.)

new formation of blood-vessels. That fungiform excrescences cover the thickened mucous membrane, which contains small cysts lined with cylindric epithelium and containing epithelial cells, leukocytes, and detritus.

The *bacteria* of the discharges are staphylococci, streptococci, and saprophytes.

Prognosis.—Untreated, some cases, after discharging for a year or two, finally cease discharging, the perforation in the membrana closes, and the hearing, while not entirely normal, becomes fairly good. This result is most likely to occur in cases with perforations similar to those shown in Fig. 225, 1–3. In other cases, where there is a large destruction of the membrane, the discharge ceases for a time only to recur at intervals. In this class of cases there is only occasionally an apparent discharge, which for long intervals

never appears externally. A scanty discharge, mixed with dust and other materials, dries at the fundus of the canal until it becomes a source of irritation, when, perhaps partly as the result of a cold, an abundant otorrhea is set up which sweeps away the old inspissated accumulations. Gradually this abundant otorrhea subsides until for another period no discharge appears externally. This is not an infrequent termination in cases where there is a large destruction of the membrane, as in Figs. 224 and 225, 4. In cases of this character occasional careful cleansing of the ear and in the case of a recurrent discharge one or two applications at intervals of a day of a 10 per cent. solution of argyrol will maintain the ear in a fairly satisfactory condition. Often the hearing is fairly good. The mucous membrane of the inner wall of the tympanum rarely epidermatizes and becomes entirely dry. Occasionally, where there is as nearly a complete destruction of the drum-head as in Fig. 224, the opening will become closed by a huge thin cicatrice, which, ballooning inward and outward with every change in intratympanic pressure, is rather a hindrance than an aid to hearing, but serves to exclude cold, dust, and other irritants.

Cases where there is a small opening in or just below Shrapnell's membrane leading to carious bone or an accumulation of filth (cholesteatomatous material) discharge indefinitely a scanty, watery fluid which sometimes dries upon the tympanum, forming an accurate cast of that structure when removed. Such so-called "attic cases" (Fig. 225, 6–12) are always a source of greater danger in the production of mastoid and intracranial complications than other forms of chronic otorrhea; although many attic cases reach a ripe old age, with no more serious discomfort than partial deafness and a scanty discharge.

In *chronic otorrhea*, the result of tuberculous infection, it is very difficult to bring about a cure of the suppuration even by the most radical operations. However, such cases usually die from the concomitant phthisis before the tuberculosis of the ear has progressed sufficiently to render a radical mastoid operation justifiable.

The *treatment* of uncomplicated cases consists in daily

thorough cleansing of the interior of the drum, already described as necessary in the treatment of acute purulent inflammation of the middle ear. If the perforation through the membrana is not sufficiently large to permit of this being readily accomplished it should be enlarged or a counter-opening made, and the interior of the drum syringed by means of Blake's middle-ear cannula (Fig. 38, 2, 3, or 4). When, with a large perforation, pus is seen to flow downward from the attic into the tympanum, the nozzle of the curved cannula should be introduced into the attic through the perforation, so as to thoroughly cleanse this cavity.

After the cavity has been thoroughly cleansed it should be dried carefully by means of absorbent cotton wrapped about a probe and the parts covered by powdered boric acid. The success of the treatment depends upon the thoroughness with which the cleansing is accomplished at each daily visit of the patient.

If the tympanic mucous membrane is granular the routine treatment outlined above will not be sufficient to secure a speedy cessation of the discharge until the granulations are destroyed. Alcohol has the power to cause a shrinking of the granulations because of its dehydrating qualities, and absolute alcohol may be applied by means of a cotton-tipped probe at each daily visit of the patient after the ear has been thoroughly cleansed. The application of absolute alcohol causes some pain, and it may augment the discharge for a few days. Alcohol (95 per cent.) may also be prescribed for the patient's use at home, a few drops being instilled into the ear several times a day, care being exercised that the patient's head is held in such a position each time that the alcohol dropped into the ear will be sure to reach the cavity of the tympanum. For the first few days it may be necessary to dilute the alcohol somewhat because of pain. However, it should be remembered that the dehydrating properties of 50 per cent. alcohol are practically nothing. A good method of prescribing alcohol is to instruct the patient to mix in a 2-dram vial equal parts of alcohol and water for the first day's use. If this mixture causes only momentary pain, to use the next day 2 parts alcohol

and 1 part water, and so on from day to day until 95 per cent. alcohol can be used without great distress.

Before dropping alcohol into his ear the patient or one of his friends should be instructed to remove all accumulations of pus from the ear in the following manner: The auditory canal is first straightened by drawing the auricle upward, backward, and outward. A cotton-tipped wooden tooth-pick is then inserted gently to the bottom of the canal, allowed to rest there sufficiently long to absorb pus, and then withdrawn and discarded. This procedure is repeated until the cotton fails to absorb and bring away any discharge.

In case of a child, where the parent or nurse cleanses the ear, the child should be placed in front of a window before the canal is straightened, so that the light may be directed into the ear and a view of the fundus of the canal obtained.

Cleansing the ear by some method is absolutely necessary before dropping alcohol into it, as otherwise the alcohol will be diluted and the tissues protected by a layer of pus so thick in most instances that the alcohol will never reach the diseased parts.

If it is deemed wise to order the patient to cleanse his ears with a syringe, he should be carefully instructed as to the proper method (p. 356), and, what is probably of as great importance, the proper method of drying the ear.

Discharging ears do better under a treatment in which syringing has little or no part. Nevertheless it is well at the first treatment of a patient with chronic otorrhea to begin by a thorough cleansing of the canal and tympanum by syringing with sublimate solution.

The writer has very serious doubts as to the value of home syringing, either by the patient or his friends. A girl about twelve years of age was brought to the Medico-Chirurgical Ear Dispensary some years ago almost totally deaf and with double facial paralysis as the result of scarlet fever. The odor from the child's ears was indescribably fetid. The mother stated that she had syringed the child's ears every day for the past six months. From the child's left ear there was quickly syringed a fetid mass of pus, the malleus, the incus, and part of the annulus tympanicus; from the right ear, fetid pus and the malleus. In six months of daily syr-

inging the parent had evidently failed to remove any of the accumulation at the fundus of the auditory canal, but had simply syringed away some of its superficial portion. The case illustrates the value of home syringing of the ear as ordinarily performed.

For the patient's use the syringe made of a single piece of soft rubber (Fig. 48) is probably the safest and most effective instrument. All things considered, a warm saturated solution of boric acid is the most convenient detergent ear-wash for home use. The patient should be instructed to place 1 or 2 teaspoonfuls of the crystals in a wide-mouthed bottle holding about 4 ounces, fill the bottle with warm water, syringe the ear, and afterward cork the bottle. At each subsequent syringing a sufficient amount of boiling water from the teakettle is added to bring the saturated solution of boric acid up to a temperature suitable for syringing the ear. As the crystals of boric acid are dissolved more should be added from time to time in order to maintain a saturated solution of boric acid conveniently ready for use.

While the above furnishes a cheap and convenient method of cleansing the ear, the writer's feeling is that most cases of acute and chronic suppuration, under ordinary circumstances of ready access to the aurist's office or the dispensary, do better without home syringing; and that when alcohol or other drops are prescribed for home use, they are best dropped into the ear after a dry cleansing with absorbent cotton.

Aural Polypi.—When the granulations are isolated they may be scraped away with a sharp curet or be removed with the forceps. Large granulations and polypi are best removed with a snare. It should be borne in mind, when removing a polypus with a snare, that, although the polypus is absolutely devoid of sensation, the wall of the auditory canal, as the result of long maceration in pus, is often exquisitely sensitive, and in guiding the wire loop of the snare over the polypus it is advisable to avoid, as far as possible, touching the auditory canal. If the polypus is large an effort should be made to locate its pedicle by means of a probe. The wire loop of the snare should then be

worked gradually inward over its surface until, if possible, the pedicle of the polypus is encircled. The wire loop should then be tightened to cut through the polypus. If the operator has not succeeded at the first attempt in removing the

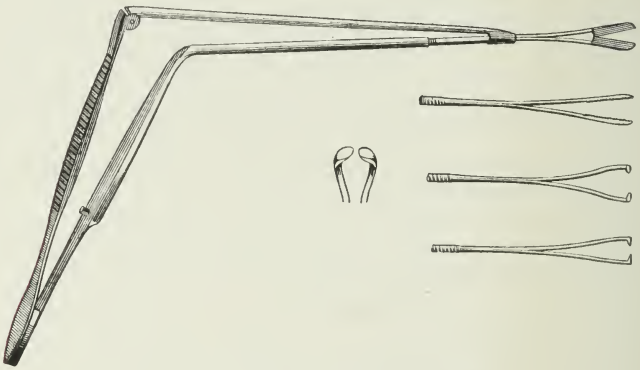


FIG. 226.—Sexton's combination forceps.

whole of the polypus, this maneuver may be repeated until the desired result has been accomplished. Bleeding may be checked at any stage of the operation by means of a tampon of absorbent cotton saturated with a 1 : 1000 solution of

FIG. 227.—Gleason's polypus snare.

adrenalin, and by afterward cauterizing the stump of the polypus with nitrate of silver fused on the end of a probe.

For the removal of polypi Blake's snare (Fig. 223) is perhaps the most convenient instrument, but Sexton's, Gruber's, or Wild's snare is almost equally efficient. The author

has had made an aural polypus snare consisting of a needle and cannula, so constructed as to be used as an auxiliary "tip" with Sexton's combination forceps, so that when the eye of the needle is threaded with wire the loop so formed can be enlarged or diminished at the pleasure of the operator—a matter of some importance in guiding it along the auditory canal over a large polypus. Other advantages of this instrument are the quickness and ease with which it can be manipulated, and the fact that when the wire is in position around a small polypus the *cannula* can be thrust forward over the wire loop, and thus prevent the wire slipping over the polypus instead of excising it (Fig. 227).

Pathology.—Aural polypi (Fig. 228) may be divided into four classes. About 50 per cent. of all aural polypi are granulation tumors, having the same structure as ordinary granulations, but covered by either squamous or columnar epithelium; 90 per cent. of aural polypi, other than granulation tumors, are mucous papillomata. They are extremely vascular and sometimes bleed at the slightest touch. Their structure consists of capillary loops surrounded by a stroma of somewhat imperfectly developed connective tissue containing cuboidal epithelial cells. They are covered by a pavement-epithelial layer of varying thickness. Fibroid polypi (fibromata), which are somewhat rare, are usually found as large, dense, pale polypi developed from the periosteal or deeper layer of the tympanic mucous membrane. Fibrous polypi are also covered by several layers of pavement epithelium. Myxomatous polypi are very rarely found in the human ear. Aural polypi are not malignant, the treatment outlined above being sufficient to prevent a recurrence of the growth. It should be borne in mind, however, that epitheliomata, sarcomata, and gummata some-

FIG. 228.—Polypi (Steudener).

times occur in the middle ear and present the appearance of polypi, but such growths are rare in this situation.

Symptoms.—Long-continued discharge, often streaked with blood, is usually the only subjective symptom. Certain reflex symptoms, the result of peripheral irritation caused by the presence of an aural polypus, have been described as occurring in rare cases.

Most aural polypi have their origin at the posterior and upper part of the tympanum. They may, however, arise from any part of the tympanic cavity or even from the dermic layer of the drum-head. Sometimes they originate at the mouth of a sinus extending through the skin of the auditory canal to carious or necrosed bone.

Caries and Necrosis.—Caries or necrosis of the temporal bone may occur during the course of long-continued suppuration of the middle ear or as the result of syphilis, tuberculosis, trauma, osteomyelitis, and diabetes. The upper and posterior part of the auditory canal, the mastoid, and the tegmen of the tympanum and antrum are the portions most usually first attacked. Caries most frequently attacks the cancellous, necrosis, the compact bone.

Symptoms.—Circumscribed caries may exist within the tympanum during chronic purulent disease of the middle ear and present no symptoms other than that exposed and roughened bone can be detected by means of a probe. Sudden paralysis of the facial nerve may occur as the result of necrosis of the inner wall of the tympanum involving the facial canal; however, a considerable portion of the facial canal may be opened and the nerve be bathed in pus for some time before symptoms of Bell's palsy occur. The labyrinth may be opened, generally through the horizontal semicircular canal, and brain-abscess occur. The tegmen tympani and tegmen mastoideum not infrequently are destroyed as the result of necrosis or caries. Under such circumstances there commonly occurs a local pachymeningitis, which prevents the spreading of the disease upon the dura mater. Pus may find its way into the nasopharynx or beneath the tissues about the auricle.

If caries or necrosis attacks the mastoid antrum or the mastoid cells, there are pain, swelling, and infiltration of the

skin at the posterior inner portions of the meatus. At first hard, the swelling becomes soft and fluctuating when pus forms. Pain is often severe, of a boring character, and worse at night. The discharges are usually abundant and characteristically fetid, due to the presence of saprophytic bacteria.

In necrosis involving the labyrinth there is often nausea, vertigo, and a tendency to fall toward the affected side, the fluids of the labyrinth may escape, producing total deafness. Temperature varies from slightly above normal to 105° F. in the more acute cases. In the absence of temperature the leukocytes are less than normal and anemia is usually present. Polymorphonuclear leukocytes are found in cases of rapid necrosis and high temperature.

The necrosed bone in the more chronic cases is usually imbedded in exuberant granulations, through which a probe detects, by the sensation of a rough surface, necrosed bone. If a cotten-tipped probe is used the rough surface catches in the fibers of cotton, producing a characteristic sensation.

Treatment.—If a sequestrum has formed it should be removed with forceps. Politzer's forceps (Fig. 206) are usually strong enough for this purpose, but Sexton's foreign-body forceps can often be used to better advantage. If it be found impossible to remove the sequestrum through the auditory canal because of the granulations and polypi that obstruct the canal, they should be removed by means of a snare ; after a few days, in some instances, the sequestrum will have been pushed outward by the granulations behind it into a position where it can readily be grasped by forceps and removed.

In cases of caries or where the necrotic process has not progressed to the formation of a sequestrum, the diseased bone should be scraped away by means of a sharp curet and the parts covered with powdered boric acid. When caries or necrosis affects the promontory, only the most superficial cureting is justifiable, but the parts should be kept scrupulously clean and as *dry* as possible by means of frequent insufflations of powdered boric acid. Cases where necrosed bone can be felt in a portion of the tympanum inaccessible to the curet are best treated by instillations twice

a day of enzymol (Formula 13), a preparation containing pepsin. By this means the middle ear is, as it were, converted into a stomach capable of digesting the dead bone. Pepsin, of course, has no effect on living tissue. The ear should first be cleansed by syringing with warm water. The patient should then lie down with the diseased ear uppermost and fill the canal full of enzymol. By pressing the tragus inward a few times with the finger-tip the fluid is syringed, as it were, back and forth as far as the aditus and antrum. The excess of fluid is allowed to escape when the patient assumes the erect posture. Several hours are required for pepsin to produce its effect as a digestant and the presence of granulations may prevent its coming into contact with dead bone. It is well, therefore, after enzymol has been used for a few days, to employ instillations of alcohol for a day or two.

The *prognosis*, of course, varies according to the part of the tympanum attacked by necrosis. In individuals otherwise healthy the prospects of a favorable result are encouraging, even when a large portion of the temporal bone is involved by the disease. In tuberculous individuals, however, the disease sometimes progresses toward a fatal termination notwithstanding all efforts to prevent it. The prognosis is doubtful where there are symptoms of intracranical involvement, pyemia, or metastatic abscess. Fatal hemorrhage may occur from the carotid when its bony canal is involved. The rupture of the vessel usually occurs at "Hassler's site of predilection," that is, at the knee of the carotid in the bony canal, where it abruptly changes its course from the vertical to the horizontal.

SYSTEMIC DISEASES CAUSING OTIC INFLAMMATION.

The systemic diseases most frequently causing otitis are scarlet fever, measles, diphtheria, la grippe, typhoid fever, pneumonia, syphilis, tuberculosis, and diabetes.

The appearance of otic inflammation in most of these diseases is a very serious complication, and although the subject has been already discussed in sections on the etiology and pathology of the various forms of otitis, it seems

best to state briefly the peculiarities of the otitis resulting from these systemic diseases and the modification of treatment necessary.

Scarlatina.—The middle ear is frequently involved during scarlet fever. In some cases the inflammation seems to be simply catarrhal in character, probably due to closure of the Eustachian tube rather than the actual presence of the micro-organism causing the disease. Such cases run a mild course. There may not be perforation of the membrana. The deafness resulting in those cases where no perforation has occurred is often considerable.

When the ear complication occurs during the eruptive stage of scarlet fever it usually assumes a severe purulent type. The membrana and ossicles may come away as a slough in a surprisingly short space of time and, finally, large sequestra of bone. The purulent inflammation may involve the labyrinth, with resulting total deafness, or the facial nerve, causing facial paralysis.

There is one practical point the practitioner should never forget, which is that the contagion sometimes lingers for several months in the discharge from the ear, and that a child with scarlatinal otorrhea may be the source of infection to other children.

The *treatment* of scarlatinal otitis differs in no respect from that of otitis from other causes, providing the condition of the patient will permit of its being carried out. The nose and throat should be cleansed once a day by the medical attendant with an atomizer containing Dobell's solution. The nose, if stenosed, should then be sprayed with adrenalin solution (1 : 5000) to overcome the stenosis and, finally, the mucous membrane covered with the spray of menthol-camphor-albolene and powdered calomel.

The ears should then be politzerized and, if discharging gently, syringed with a saturated boric acid solution and a piece of iodoform gauze placed loosely in the meatus. Every other day sublimate solution (1 : 2000) may be substituted for the boric acid solution should the gravity of the case seem to require it.

In some cases the patient, especially if a child, will be too weak or indocile to permit of so lengthy a treatment, and

the practitioner may have to content himself with simply syringing with boric acid and sublimate solution.

Sequestra of necrosed bone, polypi, mastoid complications, and intracranial involvement, if the condition of the patient permit, should be treated in the manner described in other sections.

Measles.—The ear is usually affected in measles, but with less virulence than in scarlatina. The condition is usually that of the catarrhal type, acute or subacute. Rarely does perforation occur.

Treatment is the same as in similar types of otitis from other causes.

Diphtheria.—Otitis media purulenta is not very infrequent in diphtheria. When the drum is perforated pseudomembranes may extend from the middle ear onto the excoriated skin of the canal. In those with otorrhea, diphtheritic pseudomembranous infection may occur in the tympanum if they are brought into contact with diphtheritic patients.

Treatment is similar to otitis from other causes. When the membrana has ruptured and a pseudomembrane is visible the condition should be treated as described in the section on Diphtheria of the Meatus.

La Grippe.—Aural complications in epidemics of influenza are very frequently encountered. Minute hemorrhages into the drum-head or beneath the epidermis of the canal are not infrequently encountered and are somewhat characteristic of the disease.

The aural complications vary from a subacute catarrh, from which recovery takes place within a short time, to severe otitis media purulenta with intracranial complications. The possible gravity of an aural complication in a case of influenza should not be underestimated, and such a case should receive the most careful attention from its onset.

The *treatment* is similar to otitis from other causes.

Typhoid Fever.—The hebetude and apparent deafness of typhoid is due to the effect of the toxins of the disease on the internal ear. Occasionally internal-ear impairment of hearing is encountered years after recovery from the fever.

Purulent inflammation of the middle ear is the result of invasion of the bacterium coli into the middle ear. Day

and Jackson, of Pittsburg, describe three types of purulent otitis in typhoid—the hemorrhagic, the slow, and the fulminating. The disease is usually rapid in its onset and characterized by intense pain. Day and Jackson state that in 10 cases no otitis was manifest one or two days previous to spontaneous rupture of the membrana.

In the Medico-Chirurgical Hospital during the Spanish war, of 268 soldiers sick from typhoid fever 3 had severe otitis media purulenta as a complication of the disease.

The ear complications of typhoid occur usually in the third or fourth week. The symptoms vary from those of subacute catarrh to the severe form of middle-ear suppuration. Hemorrhagic blebs similar to those encountered in aural influenza have been observed by Day and Jackson previous to rupture of the drum-head.

The *treatment* is that of otitis elsewhere when the condition of the patient will permit. The danger of heart failure from sitting up in bed, and nasal hemorrhage as the result of using the spray and Politzer bag should be borne in mind. A troublesome nasal hemorrhage apparently did originate in one of the cases treated in the Medico-Chirurgical Hospital from the use of the atomizer. In some cases, for a few days at least, it is best to be content with simply syringing the meatus with boric acid solution twice a day and inserting a little iodoform gause *loosely* into the concha. It is better to avoid inserting gauze into the canal, especially if the dressing be entrusted to a nurse, for fear that the gauze will become impacted from some cause, possibly the finger of the patient. The gauze should be changed as often as it becomes saturated. Pressure-pain with bulging of the drum-head will indicate paracentesis.

Tuberculosis of the middle ear is probably always secondary to phthisis. Tuberculous deposits occur in the middle ear, which, after a time, break down, causing more or less rapid destruction of tissue. The most marked symptom is the *painless character* of the otitis media purulenta that results in perforation of the membrana. After a considerable destruction of the drum-head has occurred the parts not infrequently become sensitive, probably as the result of mixed infection. Ordinarily the disease pursues a chronic

course and the otorrhea may even cease for a time and reappear.

Sometimes the destruction of tissue is rapid and the disease extends to the mastoid, necessitating operation. Caries of the bone may involve the facial nerve and cause facial paralysis or the internal ear may be invaded. Pus, in the more severe forms of the disease, is abundant and fetid, but tubercle bacilli are not usually numerous nor easy to find in the discharges.

It should be borne in mind in this connection that otitis media purulenta may occur in a tuberculous individual without the disease being due to tuberculosis.

Treatment.—The general treatment is of primary importance and consists of a diet largely of milk and raw eggs, outdoor life, and tonics. Local treatment is usually not very successful in bringing about a cessation of the discharge. The parts, however, in middle-ear suppuration should be kept clean, either by the dry method or by syringing with boric acid and sublimate solution. It should be borne in mind that the discharges are contagious and care should be exercised to destroy all dressings used about the ear.

Pneumonia.—As in typhoid, otitis media purulenta generally occurs late in the disease, if at all. The pneumococcus is not infrequently found in the pus of an otorrhea occurring independent of pneumonia.

The *treatment* is the same as in otitis occurring from other causes.

Syphilis.—The middle ear is frequently inflamed during the period of secondary skin rashes and sore throat. In a case observed by the author facial paralysis occurred. The middle ear may become the seat of a gumma in the tertiary period of the disease. The symptoms at first are those of pressure within the middle ear, deafness, tinnitus, and sometimes vertigo. Sooner or later suppuration with perforation of the membrane occurs, and the disease assumes the appearance of chronic otitis media purulenta. The destruction of tissue is often considerable.

Treatment.—The local treatment is that of otitis; the constitutional treatment being of greater importance. In cases where the diagnosis of gumma is made early, inunc-

tions of mercury with iodid of potassium internally may result in absorption of the gumma before it breaks down.

Bright's Disease.—In advanced Bright's disease all operations under a general anesthetic about the nose, throat, and ear are dangerous because of the possibility of fatal coma.

Diabetes.—Recurrent furunculosis of the canal may result from glycosuria. Mastoid wounds and large wounds about the upper respiratory tract do not heal as rapidly in well-marked glycosuria as in a normal individual, and otitis media purulenta runs a more severe course with greater destruction of tissue.

OPERATIONS UPON THE MIDDLE EAR

Operations are performed upon the middle ear for the improvement of hearing, the relief of tinnitus aurium or vertigo, and to bring about the cure of a persistent discharge from the middle ear.

The operations that have been performed from time to time are quite numerous, the following being a partial list: *Paracentesis*, single or multiple; *excision* or destruction by caustics of a portion of the membrana tympani for the purpose of establishing a permanent opening; *plicotomy* or division of the posterior fold; *section* of the anterior ligament of the malleus; *tenotomy* of the tensor tympani or stapedius muscle, or both; *division* of adhesions between the membrana and promontory or between the ossicles, etc.; *excision* of a portion of the membrana; *disarticulation* of the incudostapedial articulation or division of the descending process of the incus and mobilization of the stapes; *plastic operations* for uniting either the incus or stapes with the membrana tympani; and *removal* of one or more of the ossicles.

Myringotomy is performed for the evacuation of fluids from the cavity of the tympanum or as an exploratory incision to determine the mobility of the stapes before attempting a more radical operation. When the operation is done for the evacuation of fluids, the cut is generally made in the posterior inferior quadrant, and it should be at least 2 or 3 millimeters in length. The exploratory incision, which is made from just behind the short process, should extend im-

mediately beneath the posterior fold for a sufficient distance to cause considerable gaping of the wound, and to allow the operator to test the mobility of the stapes and observe the condition of the tympanum (Fig. 231). The operation does

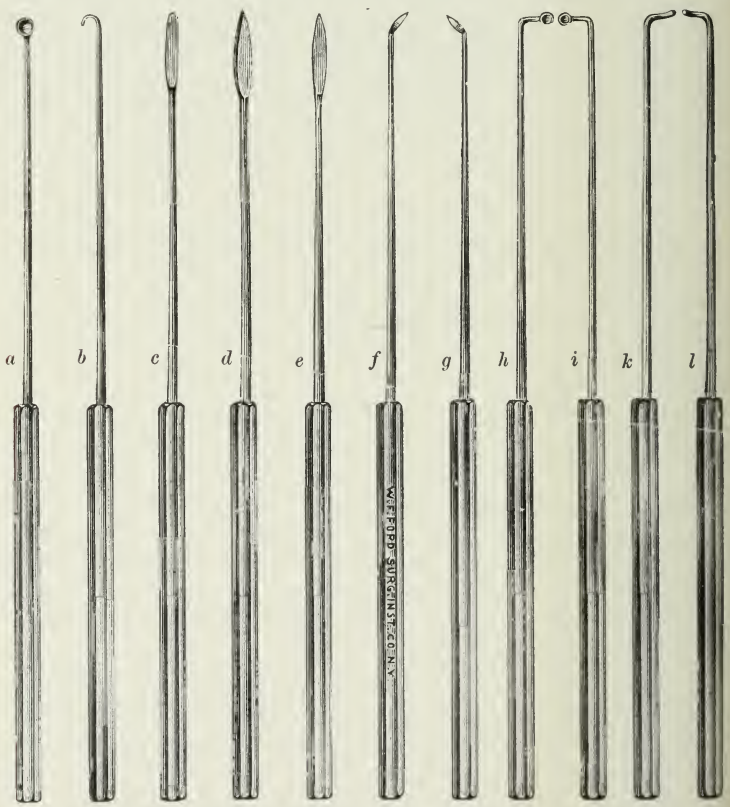


FIG. 229.—Dench's set of ear instruments.

not usually require general anesthesia, but cocain and adrenalin may be injected beneath the skin of the canal by Ballin's method (Formula 20). The hearing should be tested before and after the operation and any improvement noted. The wound of the exploratory incision is brought together and is held in position by the insufflation of a small quantity of boric acid.

Methods of Producing a Permanent Opening in the Membrana Tympani.—A portion of the membrane may be excised with a knife (Fig. 229, *c*) or removed by the method of Simrock. A minute portion of concentrated sulphuric acid is held against the membrana at the desired spot by means of a cotton-tipped probe. The acid immediately attacks the membrane and destroys that portion with which it is brought into contact, so that in the course of a few moments an opening can be made by pushing a blunt probe through the eschar. But little reaction commonly follows the operation, and the opening generally remains patulous for some time *if it is let alone*, and in some cases produces considerable improvement of the acuteness of hearing. A little powdered boric acid should be insufflated upon the parts as a dressing after the operation.

Multiple Incisions of the Membrana Tympani and Tenotomy of the Tensor Tympani.—These operations have been performed for improvement of the hearing and for the relief of tinnitus. But temporary improvement can be expected as the outcome of either operation. Section of the tensor is probably best performed in the following manner: An angular knife (Fig. 229, *f* or *g*) is thrust through the membrana tympani close in front of, or immediately behind, the malleus handle, and just below the short process. Section of the tendon is accomplished from below upward, the cut through the membrana being extended upward at the same time. The tenotomy should be followed by a vigorous inflation of the tympanum by Politzer's method, in order, if possible, to restore the drum-head to its normal position.

Removal of the Membrana Tympani, Malleus, and Incus in Chronic Catarrh of the Middle Ear.—The operation is performed for the relief of tinnitus and to improve hearing when milder measures have failed to check the progress of the disease or secure relief from tinnitus. Before determining the advisability of operating, the hearing should carefully be tested by means of tuning-forks. If it is found that the acuteness of hearing has been seriously impaired, largely as the result of impairment of the functions of the labyrinth or auditory nerve, but little if any improvement of the

hearing power can be expected as the result of the operation.

Technic.—Perfect control of the patient should be secured by the administration of ether, and the operation should be performed with antiseptic precautions. The auditory canal should first be cleansed thoroughly and syringed with a strong bichlorid solution. An electric lamp attached to the forehead (Fig. 230) will be found a convenient means of illuminating the field of operation, although some operators prefer daylight reflected into the canal by means of the forehead mirror. The advantage of the arrangement shown in the figure is that the lantern, containing an ordinary 2- or 3-candle,

FIG. 230.—Gleason's electric light for intratympanic surgery.

4- to 6-volt lamp, can be attached in place of the reflector to the head-band the aurist is accustomed to wear; and if the electric light within the lantern burns out during an operation it can almost instantly be replaced by a new one. In combination with a small 3-cell storage battery it yields a 2 to 3 candle-power light for one and a half hours, and is an extremely light and portable outfit. In a very light room 2 or 3 candle-power lamps are not entirely adequate, but by means of a current controller lamps of any candle power up to 8 may be employed. Suitable lamps for this purpose can be obtained in almost any electric supply store. Unfortunately, in the course of fifteen or twenty minutes, the appa-

ratus becomes too hot for comfort if touched with the hand when lamps of 8-candle power are used. However, most operations on the middle ear do not require a very bright light for a long period, and when the current is turned off the apparatus quickly cools. An adjustable lense focuses the light upon the field of operation and is sufficiently brilliant to be of value in a room into which the sunlight penetrates.

An incision is first made through the membrana, commencing at a point posterior to the short process and following a curve just below the posterior fold until the middle of the posterior part of the ring is reached. If the incision has been made carefully with a sharp knife in the clear part of the membrana no bleeding will occur; when the flap is pressed downward there will be brought into view the incudostapedial articulation, which is next divided by means of an angular knife (Fig. 229, *f* or *g*) passed into the tympanum, either in front of or behind the incus shank. By slight traction outward the knife is made to hug the incus shaft, while at the same time the articulation is divided by a downward stroke. Care should be exercised that the articulation is thoroughly divided before attempting any further manipulations. A puncture should now be made with the sharp knife (Fig. 229, *d*) through the membrane at its lowest portion, sufficiently large to permit the introduction of a probe-pointed knife (Fig. 229, *c*), which is made to cut its way upward until the inferior extremity of the original incision is reached. The blade of the knife is now turned in the opposite direction and the membrana is incised anteriorly up to the anterior fold. Up to this point little or no bleeding will occur to obscure the field of operation.

The next step is to divide the attachments of Shrapnell's membrane and the strong anterior ligament of the malleus. This should be done rapidly, as the hemorrhage will be somewhat profuse. The sharp-pointed knife (Fig. 229, *c*), with its handle depressed until it touches the lower margin of the speculum, is made to pierce Shrapnell's membrane just above the short process, and is thrust inward and upward into the fornix tympani, and is then made to cut its

way out downward and backward, thus severing the external and posterior ligaments of the malleus and the posterior portion of the membrana flaccida. The knife is then quickly turned, its point carried over the short process, and made to cut through the anterior segment of Shrapnell's membrane and the strong anterior ligament of the malleus. As soon as the hemorrhage, which may obscure the field of operation, has been checked, the malleus is grasped with Sexton's foreign-body forceps, and, being first pressed inward to free its head from the ledge on which it lies, is brought down and extracted. The superior ligament and the tendon of the tensor tympani both being weak no force is necessary to rupture them.

After the somewhat free hemorrhage following the extraction of the malleus has been controlled and the blood removed by means of absorbent cotton wrapped about a probe, the incus, if in sight, is seized with the forceps and removed, traction being exerted first inward, then downward and outward. Frequently the shank of the incus will not be in sight, having been displaced downward and backward during the removal of the malleus. Under these circumstances it is sought for by means of the curved probe (Fig. 229, *k* or *l*). The end of the probe is carried into the tympanum with its curve directed backward and then rotated upward, until the incus is brought into view. The maneuver will perhaps have to be repeated several times before this result is accomplished.

After the operation all blood should be removed from the tympanum and canal by means of absorbent cotton wrapped about the end of a probe and a plug of iodoform gauze loosely inserted in the auditory canal.

Many operators advise the removal of the incus before the malleus. If, after the incudostapedial articulation has been severed, the incus shank is clearly discernible, it is best, in most instances, to at once grasp and remove it with a suitable pair of forceps, thus avoiding the necessity of searching for and perhaps being unable to discover it at a subsequent stage of the operation. Before closing the auditory canal with gauze it is best in all instances to test the mobility of the stapes. If this bone is bound down by

adhesions they should be severed, and if the adhesions are so extensive as to render it probable that they will so reform as to interfere with the mobility of the stapes, the head of this bone should be grasped with forceps and extracted or it may be removed by means of a hook. Great care should be exercised not to dislocate the bone inward into the labyrinth while executing these maneuvers.

After the operation the tympanum should be dried with absorbent cotton and lightly dusted with iodoform, and the tympanum and canal very loosely packed with a narrow strip of iodoform gauze in order to check any oozing and to serve as a drain. The packing is removed at the end of twenty-four hours and, if necessary, another strip of iodoform gauze inserted, after cleansing and drying the parts by means of absorbent cotton wrapped about the end of an Allen probe (Fig. 35). Further treatment will depend upon the amount of reaction following the operation. Rarely, severe pain occurring a few hours after the operation requires the removal of the packing and *very* gentle syringing with hot distilled water to which boric acid or carbolic acid may be added. The ear should be protected by means of a pledget of absorbent cotton placed loosely in the canal, and should be changed by the patient if it becomes saturated with discharge. The parts should be inspected once a day by the surgeon, and if no discharge is present the middle ear at least should not be disturbed. If, however, there be a discharge, the parts should be gently but carefully cleansed by means of absorbent cotton dipped in a solution of peroxid of hydrogen and a little powdered boric acid dusted over the parts after they have been thoroughly dried. A slight serous discharge for a few days after the operation is not uncommon, but suppuration rarely occurs. Vertigo and nausea are generally complained of for a few days if the stapes has been roughly manipulated or removed.

Prognosis.—Tinnitus is usually at least alleviated, but the results as regards the hearing are so uncertain that there has been a growing disposition manifested to abandon this operation for simpler procedures. The operation has the advantage of permitting free access to the tympanum for subsequent mobilization of the stapes or the division of ad-

hesions should it be necessary. Ordinarily the drum-head is replaced, in whole or in part, by cicatricial tissue, which, if it interferes with the acuteness of hearing, will require removal, the operation being repeated as often as necessary; while the absence of the drum-head permits the entrance of dust and other materials into the middle ear, which consequently may readily become infected. Apparently the idea that the presence or absence of the membrana tympani greatly increases or decreases the hearing when the Eustachian tube is patulous is a myth, but the chief function of this structure—namely, the exclusion of dirt from the middle ear—is of the greatest importance, and should not be impaired by an operation for the relief of deafness and tinnitus unless absolutely necessary. In many instances equally good results, as far as the relief of tinnitus and the improvement of the hearing are concerned, can be secured by severing the incudostapedial articulation and mobilizing the stapes—with or without tenotomy of the stapedius muscle.

Severing the Incudostapedial Articulation and Mobilizing or Extracting the Stapes.—A general anesthetic may be administered, but it is preferable to operate under cocain anesthesia in order to secure the co-operation of the patient and to test his hearing from time to time during the different stages of the operation. The field of operation is prepared, upon the preceding day, by carefully cleansing the auditory canal with a solution of peroxid of hydrogen and syringing with a 1 : 2000 solution of corrosive sublimate, after which the auditory canal is stopped with a plug of iodoform gauze. All instruments, the absorbent cotton, and the solutions of cocain are sterilized in the usual manner by heat. Anesthesia is secured by the method of Ballin, which consists in subcutaneous injection into the roof of the canal of a mixture of equal quantities of a 1 per cent. solution of cocain and a 1 : 1000 solution of adrenalin (Formula 20).

Technic.—Commencing rather below the middle of the posterior periphery of the drum-head, an incision is made and prolonged upward with the probe-pointed knife (Fig. 229, *c*) through the clear portion of the drum-head close to the annulus, beneath the posterior fold, and for a short dis-

tance downward along the malleus handle (Fig. 231). Little more than a fraction of a drop of blood ordinarily follows the incision, but the flap should be turned forward, and a pledget of absorbent cotton wrapped about the end of an Allen probe and saturated with a solution of adrenalin should be held in contact with the cut surfaces and the tympanic mucous membrane until all bleeding has ceased. Before proceeding further with the operation it is well to test the patient's hearing with both the voice and the watch, in order to ascertain if any improvement in the hearing has resulted from the artificial opening in the drum-head. This is rarely the case.

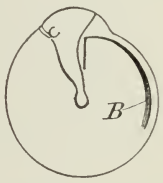


FIG. 231.—Diagram of the left membrana tympani; *B*, Incision through the drum-head.

Generally when the flap is turned forward it remains in that position, and a good view of the interior of the drum is obtained. If this is not the case, the incision should be continued downward along the posterior border of the malleus handle until the flap does not tend to close the wound and obstruct the view. The region of the round window should be carefully inspected and any abnormality noted and remedied, if possible, at a subsequent stage of the operation. If the incudostapedial articulation is not visible it is brought into view by inclining the patient's head strongly toward his opposite shoulder so that it is possible to see upward beneath the posterior fold. The incus-hook (Fig. 229, *b*) should now be passed around the descending process of the incus close to the stapes and an effort made to mobilize the ossicles by gentle traction in anterior, posterior, and lateral directions, and any improvement in the patient's hearing noted. If none occurs, the tendon of the stapedius muscle should next be divided with the point of the sharp-pointed knife (Fig. 229, *e*) by a downward stroke close behind the incudostapedial articulation. Sometimes the tendon gives way with an audible snap and immediate improvement in the patient's hearing follows. If, however, the hearing is not improved the incudostapedial articulation should be severed by means of an angular knife (Fig. 229, *f* or *g*), which is made to cut downward through the joint either from

in front of or behind the incus-shank, which it hugs closely while the downward stroke or strokes are being made. If the knife cannot readily be passed beyond the incus-shank, either in front of or behind it, the joint may be severed from below with the point of the knife. The knives (Fig. 229, *f* and *g*) are not double edged, because it is difficult to sharpen a knife of that character so that it will cut through the incudostapedial articulation readily without employing more force than is ordinarily judicious. After the incudostapedial articulation has been severed the incus-shank is pushed forward and upward in order to diminish the possibility of its tip reuniting with the stapes. After severing the incudostapedial joint, if the patient's hearing still remains unimproved, the point of the sharp-pointed knife may be cautiously carried about the head of the stapes, within the pelvis of the oval window, and an attempt made to mobilize the stapes by means of an Allen probe about the end of which a few fibers of cotton have been wrapped. The head of the stapes should be gently pressed upward, then backward, then forward, care being exercised that sufficient force is not employed to endanger fracturing the crura of the stapes, which, as the result of atrophic changes, are sometimes very fragile. If, in spite of these manipulations, the boneIet remains firmly fixed and the patient's hearing unimproved, an attempt may be made to remove the ossicle by traction with a hook. If bony ankylosis exists between the foot-plate of the stapes, Politzer has shown by experiments on the cadaver that the effort will not succeed, but that the crura will be fractured in the effort to remove the stapes. A portion of the foot-plate may, however, be removed with the fragment of the crura of the stapes and the patient's hearing improved, at least for a time.

After the completion of the operation the edges of the wound in the drum-head are brought together and supported by a small amount of boric acid or iodoform insufflated by the powder-blower. Ordinarily the edges of the wound quickly unite, but suppuration has been reported as following the operation in a few instances.

Prognosis.—In all intratympanic operations the prognosis is uncertain. Good results have been reported by numerous

operators as following severing the incudostapedial articulation and mobilizing the stapes with or without the removal of the incus. The prognosis as regards diminishing tinnitus is much better than that of improving the hearing to a useful degree.[1]

From the published reports intratympanic operations seem remarkably free from risk. In several instances, however, persistent suppuration has followed intratympanic operations in catarrhal cases. A slight amount of serous discharge for a few days after the operation is not unusual. In 1 case reported by Randall the unintentional dislocation of the incus backward into the antrum was followed by mastoid abscess requiring surgical interference. Both Ludewig and Dench have reported cases in which the facial nerve has been injured by the incus-hook, with resulting temporary facial paralysis.

Theoretically, the removal of the stapes would seem to leave the way open for infection of the labyrinth from the tympanum. When the operation is performed in suppurative cases the danger is apparent, and the fact that no cases have been reported is probably the result of the careful asepsis observed.

It seems probable that in most instances the impairment of hearing and tinnitus is due in catarrhal cases to immobility of the stapes, and that the improvement as regards tinnitus and hearing in removal of the drum-head and larger ossicles has resulted from intentional or unintentional mobilization of the stapes while severing the incus from the

[1] Of 12 cases operated upon by the author, tinnitus when present disappeared or was greatly alleviated in all, but hearing was only greatly improved in 4. In some of the cases vertigo followed the operation, persisting for a few hours, and in one instance for about three days. In 1 case—that of a bleeder—hemorrhage prevented completion of the operation, but the drum-head was subsequently opened by Simrock's method and the incudostapedial articulation severed, with the result of greatly alleviating tinnitus and slightly improving the hearing for the voice. In none of these cases was hearing for the watch permanently improved. In 1 of the 12 cases the crura of the stapes and a portion of its foot-plate were removed. In this instance nausea and vomiting followed the operation and persisted for three or four days. Vertigo also caused considerable discomfort for two or three weeks. The hearing for conversation, at first greatly improved, greatly declined, until at the end of two years the improvement, at first manifest to both the patient and her friends, became by no means so apparent. Tinnitus entirely disappeared.

stapes. It also appears probable that in most instances any improvement will not be permanent. Stapedectomy was theoretically a promising operation, but the results are disappointing, owing to the fact that in true bony ankylosis the crura are usually broken off in the effort to remove the ossicle, and only a portion, if any, of the foot-plate is brought away. Even in fortunate results following the operation the improvement could scarcely be permanent, because the progress of the disease is not prevented by the removal of the stapes. In a case of chronic otorrhea the author, while searching for a polypus in the attic or other cause of the continued discharge with Allport's curet forceps (Fig. 235), inadvertently removed the stapes. The patient had slight vertigo for some days after the accident, but the hearing (about $\frac{20}{40}$ for the watch) was neither impaired nor improved during the eight years that have elapsed since the occurrence (1899). Politzer has shown that the cause of bony ankylosis of the stapes is a "circumscribed primary affection of the labyrinthine capsule, exhibiting post mortem, in the region of the niche of the oval window, more or less sharp bony protuberances, covered mostly with normal mucosa, the neoplastic bony tissue gradually pushing aside the normal bone and attacking the oval window and stapes, producing ankylosis of the stapes. The round window may also be very much contracted."

This contribution of Politzer to our knowledge of the pathology of so-called "dry catarrh of the middle ear" is most important and fully explains the poor success following intratympanic surgery in such cases. Politzer regards the prospect of curing the disease as nearly hopeless, but thinks that its rapid progress might be stayed by the local use of iodin vapor and the internal administration of iodid of potassium.

It will readily be seen that the pathology of the ossicular articulations in this disease is somewhat similar to that of rheumatic or gouty joints in other parts of the body—a fact to which Wilde[1] and Toynbee[2] half a century ago called attention.

[1] *Diseases of the Ear*, by William R. Wilde, pp. 222, 242, 333.
[2] *Ibid.*, by Joseph Toynbee, 2d Amer. ed., p. 298.

Operations for the relief of deafness and tinnitus resulting from chronic suppuration of the middle ear are division or divulsion of false membranes and adhesions binding the ossicles together or to the tympanic walls in such a manner as to interfere with the vibration of the stapes; mobilization or removal of the stapes; removal of the remains of the drum-head and the two larger ossicles.

In most instances the first ossicle to become carious or necrosed as the result of chronic intratympanic suppuration is the incus, because of its imperfect blood-supply as compared with that of the other intratympanic structures. The entire bonelet may disappear as the result of a few weeks of intratympanic suppuration. Ordinarily the descending process is the first portion of the incus to disappear, thus freeing the incus. The comparatively good hearing of patients with large dry perforations of the membrana is due in many instances to the fact that the stapes is thus freed at an early stage of the suppurative process, and does not become involved by subsequent contractions and adhesions. In some instances, however, this fortunate result does not occur, and the detached stapes may be completely buried in a mass of cicatricial tissue which holds it immovable in the pelvis of the oval window. When not detached from the incus the movements of the stapes may be interfered with by bands of tissue binding the two larger ossicles together or to the tympanic wall. The most common of such bands is one extending from the long process of the incus to the tympanic wall and the malleus handle (Fig. 232).

Division or divulsion of such bands is in some instances followed by the most astonishing improvement in the hearing power and the complete relief of tinnitus. In suitable cases more permanent results are secured by divulsion or stretching of the bands than by cutting them. In some cases the vibrations of the ossicular chain are interfered with by an adhesion of the remains of the drum-head to the promontory in such a manner as to bind down the malleus handle. Under such circumstances division of the adhesion is followed by improved hearing and decreased tinnitus. In most instances divulsion of intratympanic bands and

adhesions will have to be repeated from time to time in order to secure permanent results; but as the operations are by no means formidable, when required they may be done during an ordinary office visit. In the divulsion of bands and adhesions care should be exercised that sufficient force is not employed to endanger dislocation of one of the ossicles, more especially the stapes. After division of synechiæ and surgical mobilizing of the stapes the hearing power can sometimes be increased by the use of an artificial drum-membrane; for this purpose a membrane made of paper, as first employed by Blake, answers an admirable purpose, and is sometimes followed by so much

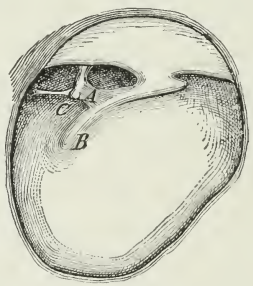


FIG. 232.—*A*, Band of connective tissue extending from the long process of the incus, *C*, to the malleus handle, *B*, which was adherent to the promontory. Hearing for the watch increased from 2 inches to 2 feet as the result of divulsing this band by gentle traction with an Allen probe, the point of which was bent nearly at a right angle and inserted underneath the band. The improvement lasted for nearly three years, when the operation was repeated with equally satisfactory results.

permanent improvement of the hearing that its use can finally be dispensed with. The permanent improvement is doubtless due to "automobilization" of the stapes during hearing as the result of wearing the disk.

The removal of the two larger ossicles, or what remains of them, is admissible as a means of improving the hearing or diminishing tinnitus; but cases are hardly conceivable in which all the improvement possible, as regards both tinnitus and hearing, cannot be secured by the division of adhesions, disarticulation of the incudostapedial joint, or mobilization of the stapes.

The *history* of intratympanic operations for the relief of deafness and tinnitus is somewhat interesting. The acci-

dental rupture of the drum-head having resulted in the improvement of a deaf person's hearing, Riolan proposed making an artificial opening in the membrana tympani as a remedy for deafness. Experiments upon dogs and other animals as to the effect of the excision of a portion of the drum-head having yielded inconclusive results, Cheselden, the father of English surgery, wished to perform the operation upon a criminal condemned to death, who was to obtain his release on account of it. In a foot-note Wilde[1] says that the case is referred to in Walpole's *Reminiscences*, where it is stated that the criminal was the surgeon's cousin; and that he was actually pardoned through the intercessions of Lady Suffolk (mistress to George II.), who, being deaf, wished to have the experiment tried; but the operation was not performed, owing to the popular outcry against it.

In 1800, Mr. (afterward Sir) Astley Cooper published a letter in the *Philosophical Transactions* entitled "Observations on the Effects which take place from the Destruction of the Membrana Tympani of the Ear," and soon afterward obtained a medal from the Royal Society on account of the success that, in a few cases, followed the operation of puncturing the drum-head for the relief of deafness.

Toynbee[2] says of the operation: "In Sir Astley Cooper's successful cases there was simple obstruction of the Eustachian tube; and there is little doubt that the affection would have yielded to simpler measures having for their object the removal of the obstruction, while the cure, instead of being temporary, would have been permanent. In the great majority of cases where Sir Astley Cooper punctured the membrana tympani not the slightest benefit accrued, because the deafness was dependent upon other causes than obstruction of the Eustachian tube; and in some cases of deafness from debility of the auditory nerve the shock of the operation greatly aggravated the symptoms."

In 1846, Dr. Butcher read a paper before the Dublin Surgical Society on the evil results of perforating the mem-

[1] *Diseases of the Ear*, by William R. Wilde, p. 33.
[2] *Ibid.*, by Joseph Toynbee, p. 240.

brana, and reported two deaths as having apparently occurred as the result of the operation.[1]

Notwithstanding the fact that Sir Astley Cooper soon abandoned perforating the drum-head as a remedy for deafness, his instruments and the technic of his operation were modified and improved by Himley, Itard, Delau, Fabrigi, and others; while the operation became very common upon the continent of Europe, but was gradually nearly abandoned there also.

The operation of the removal of the drum-head, malleus, and incus was first done in America at New York, in 1886, by Samuel Sexton,[2] and shortly afterward (1888) in Philadelphia, by Burnett. The operation soon became very common and bad results multiplied. At the present time the operation for the removal of the drum-head, malleus, and incus in non-suppurative cases is in bad repute, and there is a disposition to abandon it entirely. Probably even those American aurists who have performed the operation most frequently would entirely agree with Schwartze, who, as the result of an experience of more than twenty years, during which time he has done the operation each year less and less frequently, merely says of it that it is not entirely contraindicated.

In 1892, Jack[3] reported the results of 16 operations for the removal of the stapes, and in the following year the results in 32 additional cases.[4] Both Jack and Blake, of Boston, have performed the operation somewhat frequently, but without uniformly beneficial results, the larger percentage of good results being obtained in suppurative cases, where it is probable that in many of the cases operated upon an equally good result might have been secured by a simpler and less serious operation. Of the 21 cases of removal of the stapes in non-suppurative cases reported by Blake in 1893,[5] there was a noticeable improvement in the hearing

[1] Quoted by Wilde, p. 286.

[2] *The Ear and its Diseases*, by Samuel Sexton, p. 368.

[3] "Remarkable Improvement in Hearing by Removing the Stapes," by Frederick I. Jack, M. D., in *Trans. of the Amer. Otological Society*, 1892.

[4] "Further Observations on Removal of the Stapes," *Ibid.*, 1893.

[5] "Stapedectomy and other Middle-ear Operations," by Clarence J. Blake, *Ibid.*, 1893.

in only 3; and only in 2 of these 3 was there improvement in the hearing sufficient to be of any practical benefit.

Conditions preventing the cessation of a chronic discharge from the middle ear are polypi; a pulpy or granular condition of the mucous membrane; insufficient drainage, because of a small perforation or one unsuitably situated; necrosis of one or more of the ossicles or of the tympanic walls; cholesteatoma.

The *treatment* of polypi and granulations has already been described.

In some instances, where a large perforation exposes swollen or granular mucous membrane upon the promontory, rapid cessation of a chronic discharge will be brought about by lightly touching the parts once or twice a week with a 25 per cent. solution of chloracetic acid in conjunction with the treatment already advised for chronic suppuration.

The mere presence of localized spots of necrosis or caries upon one of the larger ossicles is hardly a sufficient reason for its removal. Perfect cleanliness and good drainage is ordinarily sufficient to bring about a cure of the condition. The rubbing of the parts with a cotton-tipped Allen probe that has been dipped in peroxid of hydrogen, and proper daily intratympanic syringing will have a stimulating action upon the parts and will aid the proliferation of epithelium over the diseased area. If these measures fail, the malleus and incus should be excised to permit freer access to the attic and better drainage.

When the attic has become epidermized, scales of epidermis will be exfoliated from time to time, until a little ball of cholesteatomatous material will have collected in the attic and perhaps have extended into the aditus as well. The disintegration of such masses is a common cause of chronic suppuration and the growth of polypi. In every case of long-continued suppuration the presence of cholesteatoma may be suspected. It is rare to fail to remove by intratympanic syringing of the attic cholesteatomatous scales in cases of long-continued middle-ear suppuration in which the discharge originates within this cavity. The removal of such little masses, and also the granulation-tissue or small

polypi that their presence commonly causes, will in most instances be all that is necessary to bring about a cessation of a chronic discharge that may have persisted for years. Under such circumstances the hearing is often greatly improved.

In most instances where it is necessary to resort to operative procedures for bringing about a cessation of a chronic otorrhea, the mere removal of the remains of the two larger ossicles will not be sufficient, and it is far preferable to resort to Stacke's operation, which consists in chiseling away the posterior upper wall of the bony meatus in order to gain ready access to the attic, aditus, and, if necessary, the

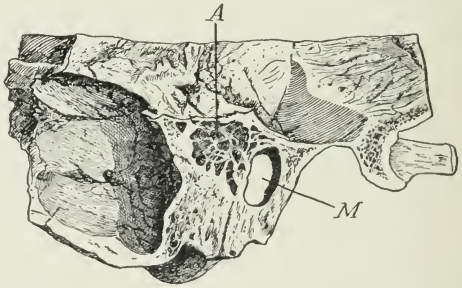


FIG. 233.—Vertical sagittal section through a left temporal bone; median surface of the lateral portion. The mastoid antrum, aditus, and attic of the tympanum are filled by a cholesteatoma. The mastoid process is sclerosed and its pneumatic cells are few and small: *A*, Antrum containing a portion of the cholesteatoma; *M*, auditory meatus. (From a photograph of a specimen in the author's collection.)

mastoid antrum. Stacke's or some similar operation would certainly be necessary to bring about a cure of the chronic otorrhea resulting from a condition similar to that existing in Figs. 233 and 234, for it will be observed that the cholesteatomatous mass occupies the mastoid antrum as well as the attic, and it would be absolutely impossible to remove such a mass except through a comparatively large opening. It should be borne in mind, however, that no operative procedure, even the establishing of a large permanent postauricular opening, can be expected to bring about a permanent cure of chronic otorrhea due to the presence of cholesteatoma. Reinhard states that membranes still continued to exfoliate in the cases that he had

operated upon by establishing a large permanent postauricular opening into the antrum, and required removal to prevent the recurrence of suppuration; "in some more frequently, sometimes but once in three years." The same rule applies to all cases of chronic suppuration where the middle ear has become epidermized. Whether an operation has been performed or not, cholesteatomatous masses will form, and their removal from time to time is necessary in order to prevent a recurrence of the suppuration.

Where the middle ear is dry, exfoliated epidermis will remain for a considerable period within it without giving rise to suppuration. In 1 case the author had succeeded in bringing about a cessation of a tedious otorrhea after the

FIG. 234.—Lateral surface of the median portion of the same specimen. A part of the auditory meatus has been cut away and the specimen tilted toward the right in order to show the membrana tympani in the photograph, which is on a somewhat larger scale than Fig. 233: *A*, Aditus containing part of the cholesteatoma, which extends into and completely fills the attic; the tegmen of the aditus and antrum is extremely thin and discolored about a small perforation that extends from the antrum into the middle cranial fossa; *MH*, malleus handle attached to the promontory throughout its entire length in such a manner that the portion of the atrium anterior to the malleus is the only part of the middle ear communicating with the Eustachian tube. The membrana tympani is cicatricial and collapsed. There are two large perforations posterior to the malleus handle and one anterior.

removal of the remains of the malleus and incus. One year afterward there were removed from his attic epidermal scales, some of which were stained with pyoktanin, which had been used in the treatment of his ear the year before.

Relapses after simple mastoid operations in cases of chronic otorrhea were notoriously frequent, and in all such cases the necessity for a secondary operation is the accumulation of cholesteatomatous masses within the middle ear. In some instances years may elapse before such masses cause marked aural symptoms, but finally suppuration occurs, and the mastoid antrum has to be reopened to

permit the removal of material that fails to find a ready exit through the tympanum and the auditory canal. Therefore it is better in cases of mastoiditis occurring in the course of chronic suppuration to do a radical rather than a simple mastoid operation.

In some instances nature does a Stacke operation as the result of necrosis of the lateral bony attic wall, or a large permanent postauricular opening may occur behind the auricle, leading directly into the antrum. In either case the middle ear becomes completely epidermized; but suppuration tends to recur if epidermal scales are not removed from time to time. The advantage of such large openings, secured either by art or by nature, is that epidermal scales and other débris can be readily removed.

Operation for the Removal of the Remains of the Drum-head, Malleus, and Incus in Suppurative Cases.—The operation is better done under cocain anesthesia by the transfusion method of Ballin (Formula 18) or a general anesthetic may be employed. However, when a large amount of the intratympanic mucous membrane is exposed as the result of disease, except in nervous patients, simply the application of a 10 per cent. solution of cocain yields fairly satisfactory anesthesia.

If the incudostapedial articulation is intact and visible, it is well to begin the operation by severing the joint, to avoid possible injury to the stapes while removing the incus. If the membrana flaccida is intact, the sharp-pointed knife (Fig. 229, *c*) is thrust through it behind the short process, as close as possible to the margin of the annulus, and the incision continued backward and downward for a sufficient distance to completely sever the posterior attachments of the malleus. Without removing the knife from the wound its edge is turned in the opposite direction, its point is slightly withdrawn so as to ride over the malleus above the short process, and the anterior attachments of the malleus are rapidly severed. The neck of the malleus is seized with Sexton's foreign-body forceps and an effort made to dislodge the head of the malleus from the scute or shelf of bone on which it lies in the lateral portion of the attic, by gentle pressure inward and downward with the forceps. Should

gentle manipulation not succeed, it is probable that the malleus is held in position by adhesions to the tympanic walls. Any adhesions that can be reached should be severed by means of angular knives (Fig. 229, *f* and *g*). By means of one of these knives or the incus-hook (Fig. 229, *b*) traction directly outward should be made upon the tip of the malleus handle until the head of the bonelet is dislodged inward. If now the bonelet be seized in the neighborhood of the short process with the foreign-body forceps it will readily be removed by traction—at first inward and downward and then outward.

The malleus when withdrawn from the ear should be inspected to determine whether or not the incus is adherent to it. In not a few instances the bonelets will be found firmly bound together by bony ankylosis or strong fibrous bands, so that both bonelets will be removed together. If this does not occur, and the presence of the incus has been determined previous to the operation by the use of an Allen probe the tip of which has been bent upward and guarded by a few fibers of cotton wrapped about it, a diligent search should be made for the incus by means of incus-hooks (Fig. 229, *k* and *l*). The incus will probably be found behind the annulus, dislocated downward and outward as the result of the withdrawal of the malleus. The tip of its long process will probably be found close behind the annulus posteriorly and somewhat below the middle of the tympanum. If the incus-hook (Fig. 229, *k* for the left ear and *l* for the right ear) be introduced into the lower part of the tympanum, with its concave surface upward and the tip of the hook behind the annulus, by lifting the hook slightly upward and at the same time rotating it the long process of the incus will probably be pushed anteriorly into view from behind the annulus. In executing this maneuver it is necessary that the tip of the hook be held somewhat closely in contact with the median surface of the annulus. The rotation of the hook may have to be repeated several times before the incus-shank is brought into view. The ossicle will probably be found lying somewhat lower down in the tympanum than would naturally be expected, but if careful manipulation of the hook fails to locate it in this region, the

ossicle should be searched for higher up, and if necessary the other hook may be inserted with its concavity downward and its tip behind the scute, and rotated in such a manner as to dislocate the ossicle downward. This maneuver should be executed with great care and gentleness, as there is danger of pushing the ossicle backward into the antrum. After the incus is brought into view it should be seized with the forceps manipulated in such a manner as to free it from the annulus and withdrawn.

It should be borne in mind that the first portion of the ossicle destroyed by caries is the long process, and that it sometimes requires but a short period of suppuration to cause the entire destruction of this ossicle. Too prolonged search for the incus after the removal of the malleus is not advisable, unless it is certain from previous examinations that the incus is certainly present.

After the withdrawal of the incus, the edge of the annulus and the tympanic vault should be carefully searched by means of a cotton-tipped probe for exposed bone or areas of granulations. If such spots be found, they should carefully be cureted by means of a bent curet (Fig. 229, *h* or *i*). The success of the operation in bringing about a cessation of persistent or recurrent suppuration will often depend upon the thoroughness and care with which this is done. Any remaining portions of the membrana should also be removed with the probe-pointed knife or with a curet.

The remains of the incus, even when firmly bound down by adhesions, polypi, and cholesteatomatous material, may readily be removed by means of Allport's ingenious curet forceps (Fig. 235). The closed blades of the instrument are introduced into the attic, then cautiously opened, and the incus or a polypus searched for. When something is felt to be within the grasp of the little curets in which the blades terminate the instrument is withdrawn. This maneuver is repeated until the attic is completely emptied of all morbid material. Sometimes comparatively large polypi—whose presence in the attic is unsuspected because they cannot be seen—are removed in this manner, and the incus, although unseen, can usually be extracted with comparative ease. Care should be used when working in the region of the

oval window not to inadvertently grasp and remove the stapes.

In operating upon the anterior or inferior portion of the tympanum the position of the carotid artery and the bulb of the jugular vein should be borne in mind (Figs. 236, 243, 259). Ordinarily the jugular vein is covered by bone of sufficient thickness to prevent injury to the vessel, but sometimes this bone is lacking and the vein lies just below the tympanic mucous membrane. Several cases of injury to the jugular vein during intratympanic operations have occurred, but without fatal results. Although no cases of injury to the carotid artery during operations upon the middle ear are known, yet the artery lies dangerously near anteriorly, and it is well to use a probe-pointed knife when

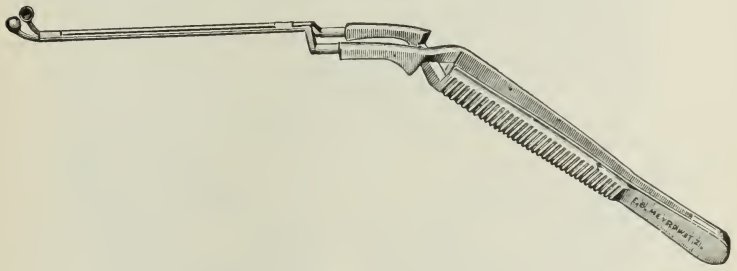


Fig. 235 —Allport's middle-ear forceps.

operating in this locality. Hemorrhage from this portion of the artery as the result of necrosis has almost invariably sooner or later terminated fatally, even after ligation of the internal carotid artery in the neck.

After the removal of the malleus and incus, if it be deemed necessary in order to gain better access to the attic for after-treatment, the lateral wall of the attic may be removed by means of the curet (Fig. 256). This procedure is somewhat more difficult than the Stacke operation (see p. 438), but can be done without displacing the auricle (a source of dread to many patients) and yields very satisfactory results.

The after-treatment of the operation for the removal of the remains of the drum-head, malleus, and incus in suppu-

rative cases is similar to that already described after operation in catarrhal cases.

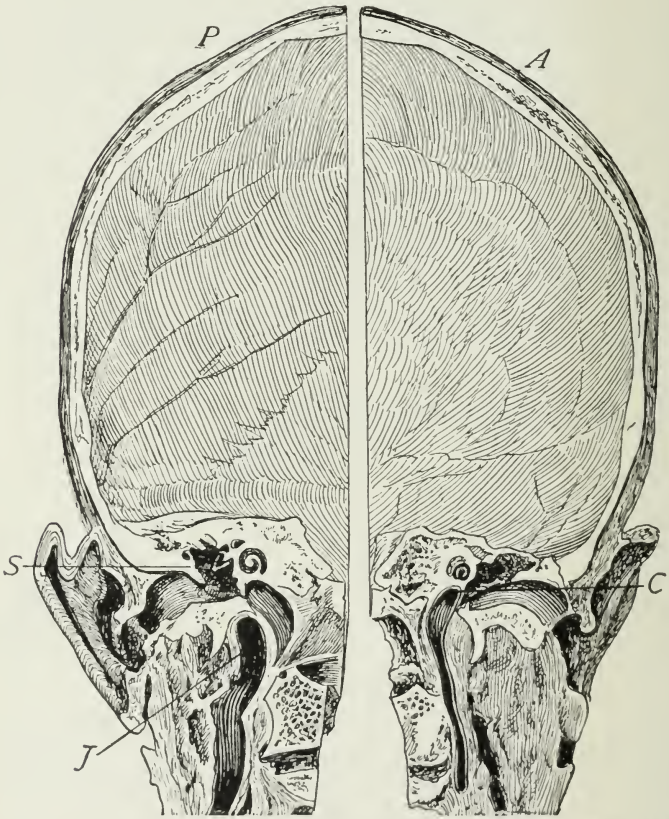


FIG. 236.—Vertical frontal section through the middle of the external meatus: *A*, Anterior *P*, posterior portion of the specimen; *S*, scute or external bony wall of attic; *C*, carotid artery; *J*, internal jugular vein. The carotid is separated from the anterior median wall of the tympanum by an extremely thin septum of bone, which in numerous instances is entirely lacking, so that the vessel might be wounded by the knife of a heedless operator during an intratympanic operation. The bulb of the jugular vein is separated from the cavity of the tympanum by the mucous membrane and a thin septum of bone that is sometimes lacking. The bulb of the jugular vein has been wounded during the operation of paracentesis. In the specimen the drum-head, malleus, and incus have disappeared as the result, probably, of chronic suppuration. (From a photograph of a dried preparation in the author's collection.)

Stacke's Operation.—The indications for the operation are caries of the walls of the tympanic cavity and ossicula; excessive growth of granulations in the tympanic cavity,

with cholesteatomatous formation in the attic; if suppuration continues for a long time in spite of careful after-treatment following a mastoid operation according to Schwartze's method, or if dangerous symptoms arise during the after-treatment.

Technic.—An incision is made to the bone, from the tip of the mastoid around the attachment of the auricle to a point

FIG. 237.—Adult temporal bone, with the upper and part of the posterior wall of the meatus chiseled away so as to form one large cavity of the meatus, tympanum, and antrum: *A*, Hard ridge of bone surrounding the Fallopian canal. Within the tympanum the oval and round windows are plainly shown. It should be borne in mind that the facial nerve arches backward above the oval window and then descends vertically (Figs. 173, 176, 239, 240). The inner end of the ridge of bone between the auditory canal and mastoid near *A* is, therefore, not far distant from this nerve, and considerable caution should be used in smoothing down this portion of the ridge, the outer portion of which can be removed quickly with rongeur forceps without pain or difficulty. In a complete Küster operation healing will be facilitated and a better final result obtained by removing not only the ridge between the canal and the operative cavity in the mastoid but also the overhanging edge of bone about this cavity, both above and behind, to render the operative cavity as flat, smooth, and shallow as possible. The root of the zygomatic process and the tip of the mastoid contain cells, and in most instances it is desirable to open these cells thoroughly. The ridge between the canal and the operative cavity and overhanging edges have been allowed to remain in Figs. 237 and 238 in order to better show the topography. (From a photograph of a preparation in the author's collection.)

above the tragus. The periosteum is then pushed forward with the anterior flap until the superior and posterior margins of the osseous canal are brought clearly into view. The cartilaginous canal and as much of the periosteum as possible are now separated from the bony canal by means of a small elevator. An incision is made through the loosened tissues as close to the drum-head as possible, and by

traction forward upon the auricle the funnel-shaped mass is pulled out of the bony canal, exposing the tympanic structures clearly to view. By means of the mallet, gouge, and curet the upper posterior wall of the inner meatus is removed, layer by layer, until the attic is fully exposed to view. If the malleus and incus are present they should then be removed with the forceps, care being exercised at every stage of the operation to protect the stapes. The chiseling should be continued until the curet no longer

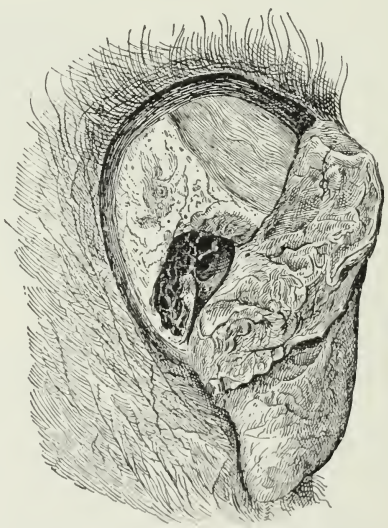


FIG. 238.—Küster's operation. The auricle is turned forward, the cartilaginous meatus detached, and the bony wall of the meatus chiseled away as in Fig. 237. The malleus and incus still remain in position, but are somewhat dimly seen in the figure. (From a photograph of a dried preparation in the author's collection.)

catches upon an overhanging ledge of bone while being drawn from the meatus. If it is thought desirable to open the antrum, the chiseling should be continued posteriorly until this cavity is freely exposed to view (Figs. 237, 238). At all stages of the operation the curet (Fig. 256) will be found a most valuable aid to the removal of the sharp edge of bone overhanging the canal. Its curved tip should be cautiously introduced into the tympanum beneath the overhanging bone, which is somewhat rapidly cut away, not by

drawing the instrument outward, but by rotating it in such a manner that the bone is cut alternately by the sharp anterior and posterior edges of the cup, the curved tip of the curet in the meanwhile preventing the instrument from becoming displaced. In order to afford a firm grasp upon the instrument while executing this maneuver, the handle of the instrument between the cups is made very broad and roughened.

After all affected parts have been removed, the attic and, if necessary, the antrum fully exposed, the soft parts are replaced, the external incision sutured, and the auditory canal lightly packed with gauze.

In some instances, where the attic is known to be occupied by pulpy granulations and cholesteatomatous masses, it is well to perform Stacke's operation after opening the mastoid antrum through the cortex of the mastoid according to Schwartze's method, subsequently to be described.

Küster, after opening the mastoid antrum by Schwartze's method, chisels away the intervening bone between the meatus and the artificial opening through the cortex of the mastoid. The disadvantage of this method is that it is somewhat slow and tedious, and that the removal of the "scute" or outer wall of the attic, being left until the last, is apt to be slighted and neglected, although the most important part of the operation, so far as accomplishing the result of affecting ultimate cessation of chronic suppuration is concerned.

Most operators prefer to use for opening the mastoid antrum, either by Schwartze's or Stacke's method, a chisel and mallet, Whiting's set of chisels and gouges (Fig. 257) being ordinarily employed for this purpose.

When chiseling away the posterior superior wall of the meatus and opening the attic, the topographic relation of the posterior wall of the meatus to the descending portion of the facial nerve should be borne in mind. The aquæductus Fallopii does not extend downward and outward, as stated in some text-books upon anatomy, but directly downward (Figs. 239, 240). Indeed, if two probes be inserted into the facial canals through the stylomastoid foramina of any skull, it will be found that the probes are parallel, or in some instances incline somewhat toward each other. Al-

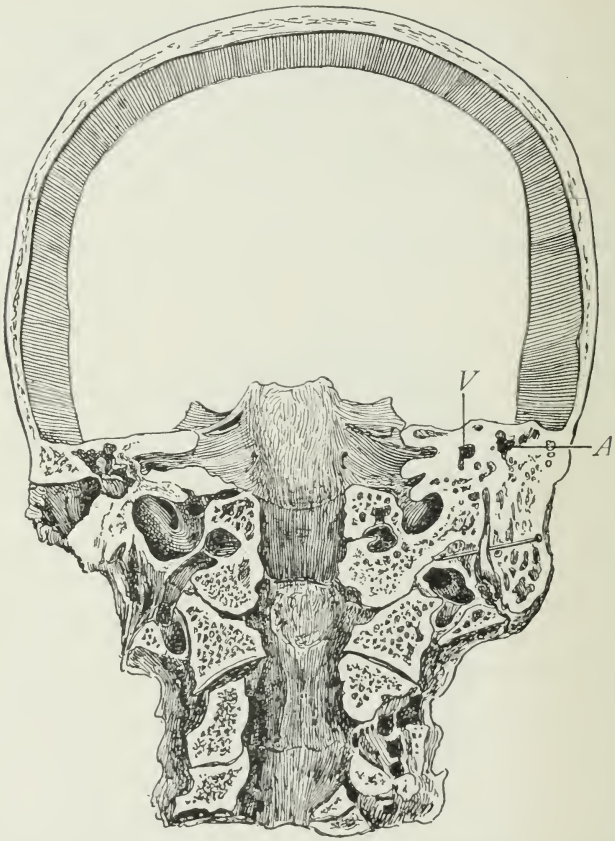


FIG. 239.—Vertical frontal section through the skull, anterior portion of the specimen seen from behind. The saw has passed through the spina on the right side and laid open the aquæductus Fallopii through its entire vertical portion, showing the facial nerve, under which a pin has been passed. It should be observed that the nerve lies nearly vertical in this part of its course, while above and *external* to it is an opening into the most external portion of the horizontal semicircular canal. The anterior part of the antrum, *A*, has been opened, and also the vestibule, *V*, and the superior semicircular canal. On the left side the saw has passed through the posterior portion of the external and internal meatus, removing the posterior edge of the drum-head and the incus. The stapes still retains its position in the oval window. Below the tympanum is the bulb of the jugular vein. In comparing Fig. 239 with Fig. 240, note that the saw has passed slightly more anteriorly through the left ear of the specimen. (From a dried preparation in the author's collection.)

though the course of the descending portion of the facial nerve is vertical, yet, because of the upward and outward inclination of the drum-head, the facial nerve approaches the annulus to within 1 or 2 millimeters posteriorly, on a

level with the center of the meatus; hence, if the whole of the posterior wall be removed, it will be impossible to avoid

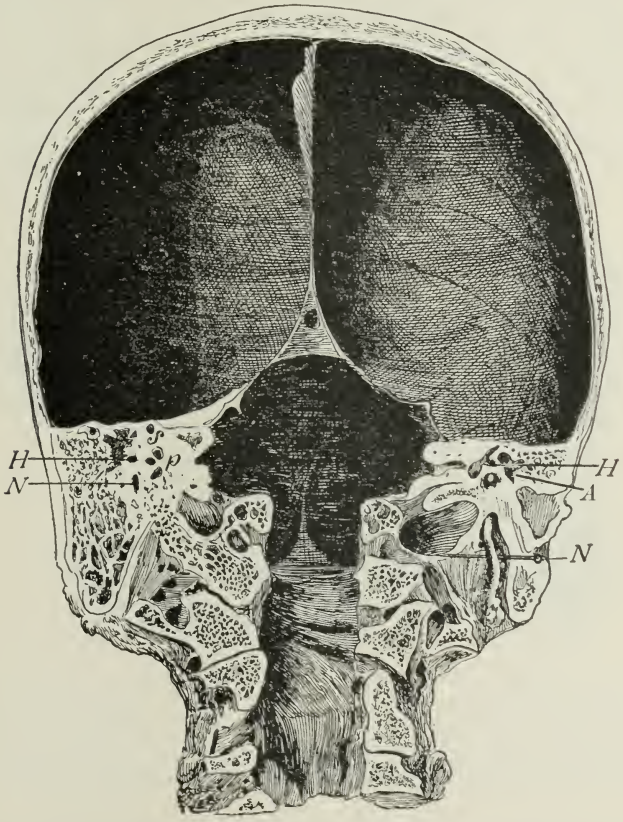


FIG. 240.—Vertical section through the skull, posterior portion of the same specimen as Fig. 239. On the left side the saw has passed just anterior to the aquæductus Fallopii, and a pin has been passed under the facial nerve, *N*, at its exit from the stylomastoid foramen. Above is seen an opening made into the commencement of the vertical portion of the facial canal. Still higher up is a portion of the horizontal semicircular canal (*H*) laid open and occupying a position somewhat *lateral* to the facial nerve and median to the aditus (*A*). On the right side the section has passed through the anterior part of the antrum and is posterior to the facial canal, and has opened the horizontal semicircular canal at its most external part. (From a dried preparation in the author's collection.)

injuring the facial nerve. The Fallopian canal is contained in a hard mass of bone (Figs. 240, 242), and hence is protected to a certain extent from injury if the operator is skil-

ful and careful. The student should study the topographic relation of the structures involved in operations upon the middle ear by preparing a large number of frontal, sagittal, and horizontal sections of the ear. Such sections should be made, not through a separated temporal bone, but while the bone is still in position in the skull. Injected heads, sawn in half through the sagittal suture and mummified by exposure upon the roof of a house for a few months, are very suitable for making such sections. After the sections

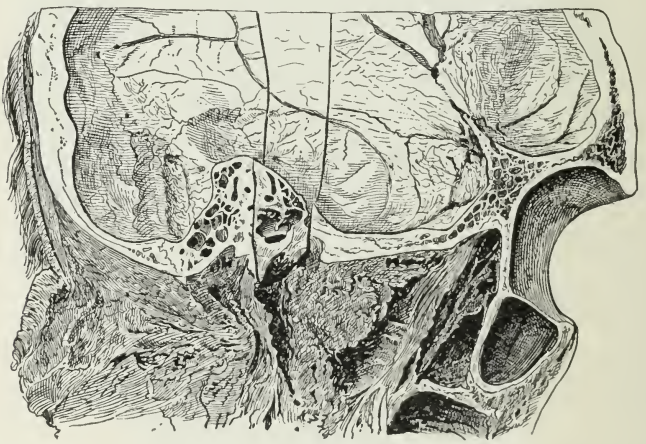


FIG. 241.—Vertical sagittal section through the tympanum; median aspect of the lateral portion of the specimen. The lower part of the membrana tympani is cut away by the saw, and above the drum-head inclines outward at an angle of 140 degrees with the upper wall of the meatus. The malleus handle and the malleo-incudal articulation, as well as the descending process of the incus, are visible. The section passes through the canal for the tensor tympani muscle, so that the trochlea and tendon are shown. Above the tympanum portions of each of the semicircular canals are visible. (From a dried preparation in the author's cabinet.)

are made the parts should be freed from fat by repeated soakings in gasoline or benzine. By careful attention to this detail the specimens may be rendered almost devoid of smell, as the foul odor originates principally in the fat of the tissues.

The specimens may be further cleansed and bleached by placing them in the sun and spraying them from time to time with an atomizer containing peroxid of hydrogen rendered slightly alkaline by the addition of liquor potassæ.

After subsequent drying the soft parts should be preserved by applying to them several coats of bleached shellac varnish, which may be made to assume any color required to render the structure more natural in appearance by the addition of one of the aniline dyes. Each coat of varnish is allowed to soak well into the soft tissues in order to preserve them. However, specimens of a large section of the head prepared in this manner are rather too realistic to show indiscriminately to office patients, as by the skilful use of

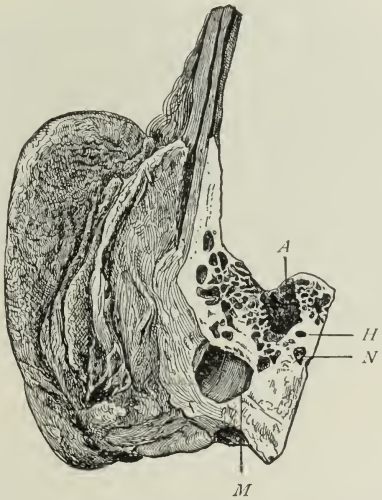


FIG. 242.—Posterior surface of the portion of the ear removed by the two vertical frontal saw-cuts seen in Fig. 241. The external bony meatus has been laid open only at its most external portion. Above, the saw has passed through the aditus and posterior to the facial canal: *A*, Aditus, with its bony roof partly removed; *H*, horizontal semicircular canal; *M*, meatus; *N*, facial nerve.

the aniline dyes they are made to look as if still bleeding and freshly severed from the body. Therefore if it is found convenient to have a few specimens like Fig. 95 or 236 for example, to aid in the explanation to patients of a proposed operation, it is better to coat such specimens with aluminum or bronze paint. The most useful sections for purposes of study are a vertical, frontal section through the spina suprameatum (Figs. 242, 248), a vertical sagittal section through the floor of the tympanum (Fig. 241), a hori-

zontal section through the roof of the meatus (Fig. 243), and a section parallel to the inner wall of the tympanum (Figs. 172, 173). Besides making the sections through the middle ear, the student would do well to operate many times upon the cadaver before attempting any serious operation involving the middle ear of a patient.

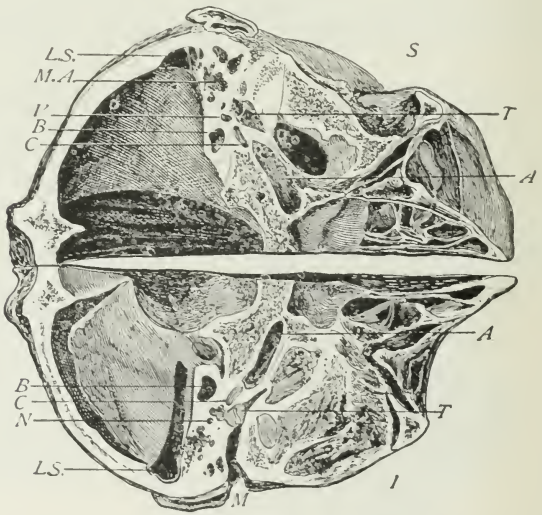


FIG. 243.—Horizontal section through the roof of the external meatus: *I*, Inferior portion; *S*, superior portion of the specimen; *M*, external auditory meatus; *T*, tympanum; *M.A*, mastoid antrum; *A*, carotid artery; *L.S*, lateral sinus; *B*, bulb of the jugular vein; *N*, facial nerve. In the lower half of the specimen is the handle and short process of the malleus, the saw having passed through the neck of the bonelet. The membrane slopes obliquely forward at an angle of 55 degrees with the axis of the meatus, and outward at an angle of 140 degrees with the roof of the meatus. The section passes through the oval window, so that the cavity of the vestibule (*V*), as well as the cochlea (*C*), is shown in the upper half of the specimen. Here also is to be seen the malleus head, the incus, the attic, and the mastoid antrum. The stapes has been removed by the saw. The bulb (*B*) of the jugular vein extends further upward than in most specimens. (Author's specimen.)

Mastoiditis.—*The External and Middle Ear of a Newborn Child.*—At birth the external meatus is essentially a closed canal. The drum-head lies nearly in the same plane with the upper wall of the meatus (Fig. 244), and forms such an extremely acute angle with the lower wall that the upper and lower walls are practically in contact except for the *vernix caseosa* (greasy paste), which, covering the entire body of the child at birth, also extends into the auditory

canal, completely blocking it up so that no air can enter. The drum-head is covered by extremely thick epidermis, while the cavity of the tympanum is usually completely filled with its own mucous membrane, which, enormously hypertrophied at all parts of the tympanum, is thickest upon the inner wall, where it is markedly hyperemic and jelly-like in appearance, in marked contrast to that of adult life, which upon the promontory is thin and nearly bloodless in appearance.

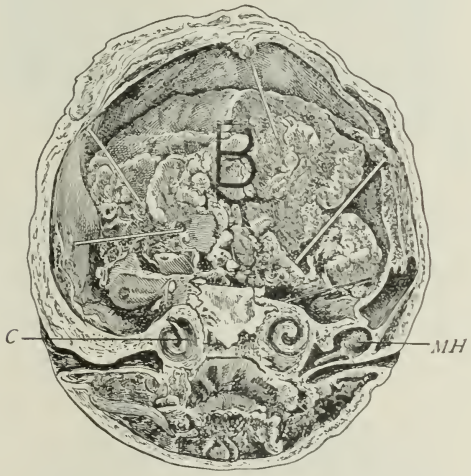


FIG. 244.—Vertical frontal section through the external auditory canals of a fetus stillborn at the end of the seventh month, anterior portion of the head. The external auditory canals slope somewhat downward and the membrana tympani are nearly horizontal. The lower wall of each canal is in contact with the upper except for the presence of a small quantity of the same cheesy material (*vernix caseosa*) that covered the rest of the skin of the fetus. The tympanum is completely filled by the ossicles and its own mucous membrane, which is much thicker than that of the adult. The malleus is in position in the right ear, but has been removed by the saw from the left: *B*, Brain; *M.H.*, head of the malleus; *C*, cochlea of the left ear. (From a specimen in the author's collection.)

Hence, the offspring of the human race is, like that of many of the lower animals, born into the world almost completely deaf. Almost from birth the eyes of an infant follow the movements of individuals about the room, but it is not until the eighth or tenth day after birth that an infant shows any evidence of hearing the sound of a tuning-fork held close to its ear. At birth or soon afterward the tympanum becomes a cavity containing air. The thick epi-

dermis of the outer layer of the drum-head is exfoliated and the mucous cushions within the tympanum disappear.

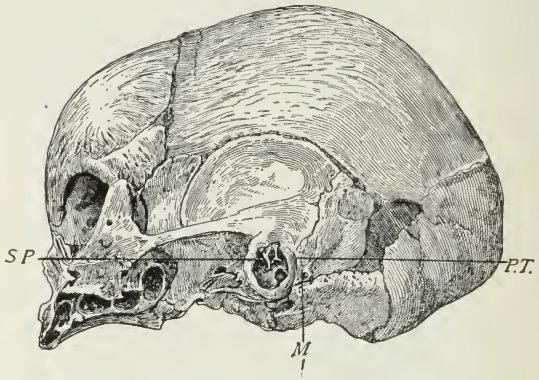


FIG. 245.—Left half of the skull of a stillborn infant, showing the inferior surface of the petrous bone, the annulus tympanicus, the ossicles, the tympanum, and the mastoid process. The ossicles, the tympanum, and the mastoid antrum are nearly as large as those of an adult: *M*, Mastoid process. The end of the line is at the stylomastoid foramen. Hence at birth the facial nerve emerges not as in the adult on the inferior, but on the lateral, surface of the temporal bone. Therefore it readily may be wounded during a mastoid operation by a careless operator or injured by too tightly packing or bandaging the mastoid wound; *S.P*, short process of the malleus; *P.T*, posterior tubercle of the annulus tympanicus. (From a specimen in the author's collection.)

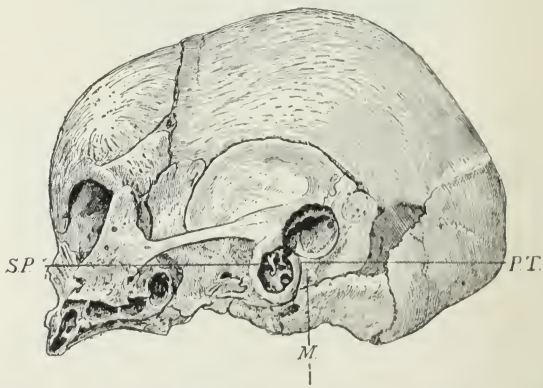


FIG. 246.—Same specimen as Fig. 245, but with the mastoid antrum exposed, showing its normal position at birth immediately above the posterior tubercle of the annulus.

The osseous canal of the adult is represented in infants by the *annulus tympanicus* or *processus auditorius* (Figs. 245, 247), one of the three separate bones comprising the

temporal, and forming by gradual development the vaginal process of the auditory meatus of the adult. The rest of the canal is composed largely of embryonic tissues covered by skin, and measures from the tragus to the umbo usually about 30 mm., while that of the adult measures from 31 to 35 mm. between the same structures. Because of the nearly horizontal position of the drum-head, Shrapnell's membrane (Fig. 172) lies so near the orifice of the canal that when

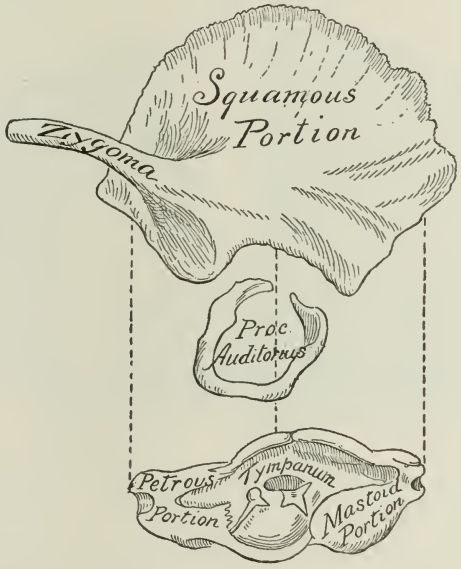


FIG. 247.—The temporal bone of a newborn child separated into its three component parts: the squamous and petrous portions and the annulus tympanicus or processus auditorius (Gray).

greatly swollen it almost protrudes, resembling a polypus somewhat in appearance; indeed, it has been mistaken for a polypus and removed, together with the malleus and incus.

To *examine the drum-head of young children* it is necessary to draw the lobule downward in order to detach the lower from the upper wall of the meatus. The ossicles, tympanum, and mastoid antrum are nearly as large as those of an adult, but are superficially situated, and in opening a mastoid abscess in an infant, therefore, it is not unusual for

the probe to pass through the antrum into the attic for a distance of nearly 1 inch. The mastoid antrum of young infants is situated immediately above the posterior tubercle of the annulus (Fig. 245), and this elevation should be searched for as a landmark when operating upon the temporal bone of infants. It should also be borne in mind that the mastoid-squamous suture (Fig. 245) is not ossified at birth, and frequently presents large dehiscences during childhood, so that when making the primary incision for a

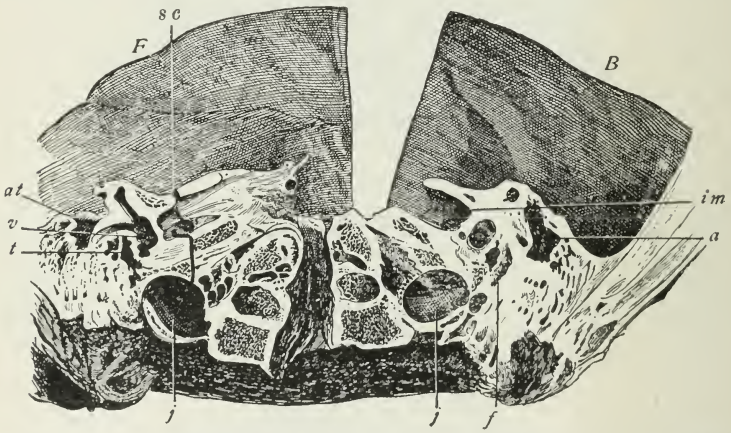


FIG. 248.—Vertical frontal section through the spina of a child eight years old: *F*, Anterior, *B*, posterior portion of the specimen; *at*, attic with tegmen removed; *v*, vestibule with horizontal and superior semicircular canals laid open; *t*, tympanum; *j*, jugular vein; *f*, aquæductus Fallopii; *a*, mastoid antrum; *i m*, internal meatus; *s c*, saw-cut through the center of the modiolus, at right angles to the tubotympanic axis, in order to lay open the cochlea. A section of this kind through the modiolus is commended to students as showing the topography of the anterior portion of the tympanum in relation to the articulation of the lower jaw and the carotid artery. (From a dry preparation in the author's collection.)

mastoid operation upon a young child the point of the knife should not be pressed with force against the bone or it may enter one of these dehiscences and penetrate the cranial cavity. The incision should be made with due deliberation until the bone is exposed in the whole length of the incision, and the periosteum pushed forward with great care and gentleness. It should be borne in mind also that at birth the *facial nerve* emerges not on the inferior surface, but on the external (lateral) surface of the temporal bone, at a point close to the annulus and somewhat above its inferior border

(Fig. 245). Unnecessary cureting within the mastoid antrum and attic should also be avoided, as the petrosquamous suture, where the horizontal plate of the squamous portion of the temporal bone unites with the petrous portion to form the tegmen or roof of the tympanum and antrum, remains open for some time after birth, and a process from the dura not infrequently extends downward to unite with the mucous membrane of the middle ear.

The Adult Mastoid Process.—At birth the mastoid process consists of a small flattened tuberosity containing but one cell, the mastoid antrum. At the age of eight years the child's mastoid generally contains numerous other pneumatic spaces radiating from the antrum, and its topographic

FIG. 249.—Large-celled pneumatic processes; the tip of the one to the left is diploëtic. (Author's specimens.)

relations are well shown in Fig. 245. At puberty the mastoid has become a distinct prominence, conic in shape, with its apex downward. It may or may not contain pneumatic cells in addition to the antrum.

Types of Mastoid Structure.—There are four distinct types of mastoid structure:

1. The pneumatic, in which the whole mastoid process is composed of pneumatic spaces communicating with each other and with the antrum, and lined with a continuation of the mucous membrane of the middle ear. The pneumatic spaces may be large (Fig. 249) or small (Fig. 250). If the pneumatic spaces are small, one comparatively large cell is generally found at the mastoid tip.

2. The diploëtic, the entire bone containing no air-spaces, but composed of diploëtic tissue.

3. The pneumodiploëtic, in which pneumatic spaces and diploëtic tissue are both found (Fig. 249).

4. The sclerosed, in which the entire bone is composed of compact bone often as hard as a tooth (Fig. 251).

Pathologic Importance of Types.—Pathologically and surgically the structure of the mastoid process is of the utmost importance. In the pneumatic type of mastoid with large cells, pus from the antrum readily finds its way to the lateral surface, but in the diploëtic, and more especially in the

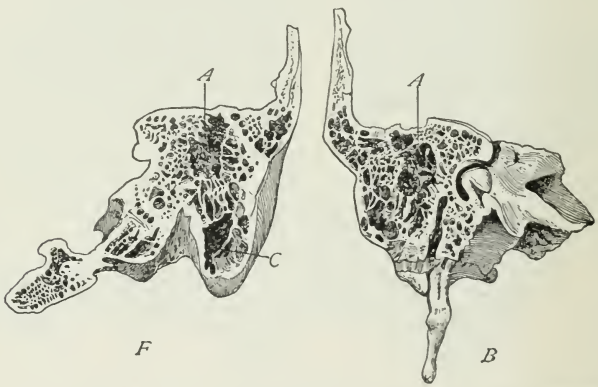


FIG. 250.—Frontal section through the spina of a mastoid process consisting almost entirely of small pneumatic cells; *F*, Anterior, *B*, posterior portion of the specimen; *A*, antrum; *C*, large cell at the tip of the process; the semicircular canals and the aquæductus Fallopii have been laid open after the section was made. (Author's specimen.)

sclerosed type, there is greater danger of pus burrowing its way into the cranial cavity. The difficulties of the mastoid operation are also greatly increased by the compactness and hardness of the bone. Where a large cell is present at the mastoid tip with a thin median wall, pus is more likely to find its way into the digastric fossæ than to penetrate the thicker external cortex.

Etiology.—Primary inflammation of the mastoid never occurs except as the result of syphilis, tuberculosis, or traumatism, especially in individuals with chronic suppuration of the tympanum and attic. The symptoms are those of acute periostitis, pain, heat, and swelling behind the ear.

Within a few days the periostitis subsides or the deeper structures become involved. In such cases should caries occur, the abscess-cavity does not usually communicate with the mastoid antrum, but is generally superficially situated beneath the cortex of the bone. However, the disease in almost every instance is the result of an extension, by continuity of structure, of inflammation from the tympanum. Politzer states that in every post mortem that he made of chronic suppuration of the middle ear the mastoid cells were diseased. Mastoiditis, then, is generally the sequence of acute inflammation of the tympanum or of chronic suppuration of the middle ear. In rare instances suppurative inflammation of the deeper portion of the auditory canal may extend under the periosteum until pus appears upon the external surface of the mastoid beneath the periosteum (Fig. 252); or infection may be transmitted by means of the veins which traverse canals passing from the meatus into the mastoid cells.

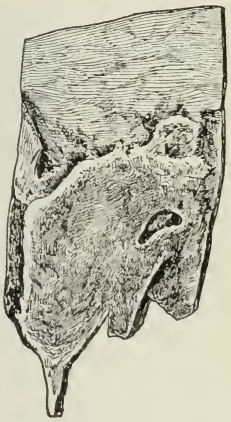


Fig. 251.—Vertical sagittal section through a sclerosed mastoid process, the cellular structure of which, with the exception of an exceedingly small antrum, has been entirely replaced by dense eburnated bone (from a specimen in the author's cabinet).

Pathology.—The most acute cases, starting in an inflammation of the mucous membrane of the middle ear and mastoid antrum, and extending to that lining the mastoid cells, run a most rapid course, but a few days elapsing between the onset of the disease and the operative opening of the mastoid necessary for the removal of pus and necrotic bone. In such cases the pain is persistent or only temporarily relieved by applications of ice to the mastoid or the administration of opiates. The patient's face assumes the expression of abject woe. He eats little and sleeps less. The infection is usually streptococci, which when present indicate rapid caries and the necessity for an early operation. The middle-ear symptoms, however, may have subsided and for weeks all signs of mastoiditis have disappeared, except perhaps slight tenderness on deep press-

ure over the bone, with occasional slight shooting pain through it, when a fluctuating swelling appears over the mastoid bone, the digastric fossæ, or in the deep tissues of the neck, indicating that spontaneous perforation of the cortex of the mastoid bone has occurred and released the contained pus.

The changes that occur in slowly progressive inflammation of the mastoid cells are of two kinds. Sometimes a limited caries is produced, the surrounding tissues being

FIG. 252.—Periostitis and caries of the petrous portion of the temporal bone after otitis media, in a boy three years of age (Fruhwald).

thickened and consolidated to the extent of entirely obliterating the pneumatic spaces. Where the active inflammation has subsided without suppuration, *hyperostosis*, or consolidation of the mastoid, may occur without necrosis or caries.

In most chronic cases the mastoid antrum becomes filled with cholesteatomatous masses, thus isolating the mastoid cells from the tympanic cavity. *Active mastoid complications* during chronic suppuration of the middle ear frequently manifest themselves during an acute exacerbation of the middle-ear disease, with the result of producing an acute inflammation of a limited area of bone in the center of a sclerosed mastoid.

Caries or necrosis of the mastoid may extend inward and

involve the lateral sinus, producing phlebitis, thrombosis, emboli, and their consequences. The middle fossa of the skull may also be penetrated and an abscess produced beneath the dura mater, a local pachymeningitis preventing further extension of the disease; or meningitis, both at the base and convexity of the brain, or brain-abscess may occur.

Symptoms.—In acute cases the first symptom is intense pain, involving the mastoid and often the whole side of the head. There are tenderness on pressure over the mastoid, fever, and in most cases swelling and congestion of the upper posterior part of the meatus. In the more chronic form of the disease the patient is sometimes remarkably free from pain, almost the first symptom to which the surgeon's attention is called being congestion of Shrapnell's membrane, with swelling at the upper posterior part of the meatus, over the mastoid, or of the neck below the ear. Especially in children, the external cortex of the mastoid may be penetrated early in the disease and the pus find its way underneath the periosteum. Under such circumstances the whole auricle, when seen from the rear, appears as if pushed out from the side of the head (Fig. 252).

A symptom of considerable diagnostic importance is *sudden cessation of discharge* from the meatus in the course of an acute otorrhea. It is probably caused by lack of sufficient drainage from the attic and antrum. If the discharge is not re-established within a few days, mastoid symptoms requiring operative interference generally manifest themselves.

In *cases requiring operation* the temperature is not a very reliable guide. In some cases it may be very little if any above the normal. Pain on pressure over the antrum or at the mastoid tip may disappear. However, when in conjunction with tenderness on pressure over the antrum, which has been present for some days, there is swelling of the posterior wall of the meatus close up to the drum-head, so that a portion of Shrapnell's membrane is hidden, an operation should not longer be delayed, as such cases rarely or never recover without. In making pressure over the antrum the observer should insert his finger at a level with

the superior border of the meatus into the angle made by the junction of the auricle with the mastoid and press upon the bone in a direction backward and inward, being careful to move the auricle as little as possible, so as not to mistake the pain commonly caused in acute suppuration of the middle ear by movements of the auricle for bone tenderness over the antrum.

A small lymphatic gland is found upon the surface of the mastoid about $\frac{1}{2}$ inch posterior to the meatus. Tenderness of this gland should not be mistaken for the bone tenderness of mastoiditis. Should this gland become infected and break down as the result of furunculosis of the canal or other causes, the pus will be beneath the skin and not beneath the periosteum, and consequently the auricle will not, when seen from the rear, appear pushed out from the side of the head (Fig. 252). Such superficial abscesses simply require opening and not a mastoid operation.

Persistent tenderness of the mastoid tip and swelling of the tissues of the neck behind and below the mastoid indicate the presence of pus in the digastric fossæ as the result of suppuration of the large cell at the tip of the mastoid. Usually the median bony wall of this cell is thinner than the external cortex and more readily breaks down. In such cases the entire tip of the mastoid should be removed at the mastoid operation and the abscess-cavity in the tissues of the neck laid freely open.

It is often difficult to make an early diagnosis of commencing otic meningitis. The chief symptom at the beginning of *brain complications* is usually headache, which, at first intermittent, soon becomes constant and increases in severity. Accompanying the headache there are restlessness, insomnia, occasional vomiting, and dulness of the intellect. If the eye be examined with the ophthalmoscope commencing optic neuritis will be discovered. In children coma frequently occurs. Dilatation of the pupil, paralysis of the accommodation, strabismus, ptosis, or paralysis of other muscles of the body may sometimes be present as the result of brain-abscess. The symptoms of phlebitis of the lateral sinus with the formation of a septic clot are chills, followed by high temperature, the characteristic temperature-

chart of septicemia. The circulation becomes checked as the result of the formation of a thrombus, which may in rare cases extend downward and backward to the torcular Herophili or into the jugular vein, where it may be felt as a hard cord, or into the mastoid vein, producing edema and inflammation of the posterior portion of the neck.

Treatment.—When there is congestion of the posterior portion of Shrapnell's membrane and swelling of the neighboring tissues of the meatus a free incision through Shrapnell's membrane and the swollen tissue will sometimes abort the attack. The mastoid process should be thickly covered with an ointment of 20 per cent. ichthyol in lanolin. The parts should then be covered with waxed paper and bandaged in order to prevent soiling the patient's clothing or bed-linen.

Pain is best combated by the application of dry heat by means of a hot-water bag. If absolutely necessary an anodyne should be administered. Pain often can be relieved entirely for days by the application of cold to the mastoid process, either in the form of an ice-bag or Leiter's coil. However, this method is becoming less popular, as cold does not control the suppurative process, but simply masks its symptoms. The application of heat is the better treatment.

Painting the mastoid process with iodin or cantharidal collodion renders the skin so sore that it is difficult to determine whether tenderness on pressure is the result of the counter-irritant or inflammation of the bone. Although a favorite method of treatment with the aurists of half a century ago, it is doubtful if counter-irritation over the mastoid ever accomplished an appreciable amount of good. The writer has been called in consultation to see 2 cases of erysipelas apparently resulting from the application of cantharidal collodion over the mastoid. One of these cases, an old man with advanced chronic Bright's disease, proved fatal.

If, notwithstanding the application of ichthyol over the mastoid, dry heat, and the systematic treatment of the tympanic suppuration, the tenderness over the mastoid is not relieved, and pain, sleeplessness, and loss of appetite increase, it is necessary to operate.

The *prognosis* in uncomplicated mastoiditis is not un-

favorable. The major portion of cases recover with or without operation. The mastoid tenderness occurring in a large proportion of cases of acute suppuration of the middle ear within a few days of the onset of the disease commonly disappears within a short time as the result of treatment. The more severe forms of the disease occurring later, providing there is no swelling of the tissues at the inner upper portion of the canal, most frequently recover without operation if properly treated, if the infection is not due to the presence of streptococci or the result of la grippe. The prognosis in scarlatina, tuberculosis, diphtheria, etc., is, of course, more uncertain, with or without operation.

The Mastoid Operation.—*History.*—The operation of opening the mastoid cells was first proposed by Riolanus about 1600. Fifty years later the performance of the operation was opposed by Sir Thomas Browne. Trephining the mastoid for the removal of the products of inflammation was first done by Jean Louis Petit, a distinguished French surgeon, who died in 1750. The Prussian military surgeon, Jasser, trephined the mastoid process in 1776. His earlier operations were done for the release of the products of inflammation and were highly successful, but he and his successors soon lost sight of the true indications for the operation, which became very popular and was frequently performed for the relief of deafness and tinnitus. Disastrous and even fatal results were somewhat numerous, and finally culminated in the death of Baron von Berger, physician to the king of Denmark. Berger had suffered for some time from noises in the ears and gradually increasing deafness without suppuration. Perforation of the mastoid cells and the injection of an astringent solution were soon followed by fever and delirium, which ended in death on the eleventh day. At the post mortem the mastoid was found to be almost rudimentary and the trephine had entered the brain. Death resulted from purulent meningitis. Because of the prostitution of this most useful operation, trephining the mastoid fell into disrepute, and for nearly a century was referred to in medical literature as one of the curiosities of surgery rather than a justifiable procedure.

The status of the mastoid operation was re-established by

the writings of Forget, in 1849, and those of Follin and von Troeltsch, in 1859. To Schwartze is due the credit of developing the mastoid operation as performed at the present time. Schwartze's first series of 100 cases, published in 1883, gave a death-rate of 20 per cent., a mortality that has been greatly decreased as the result of performing the operation earlier in the history of the disease, before intracranial complications have had time to develop.

Toynbee [1] says, "I have never performed this operation, but I should not scruple to do so in a case where the life of the patient was threatened." He describes a case where mastoiditis was cured by wearing a seton for two years at the back of the neck. Toynbee of London and Wilde of Dublin were practically the fathers of modern otology, and Toynbee's observations on the pathology of mastoiditis and its intracranial complications make interesting and instructive reading even at the present day. As indicating the number of deaths from mastoiditis in Ireland, Wilde [2] states, that while compiling the causes of deaths under the census commission of 1841, his attention was attracted to the number of cases where the cause of death returned was, "died of a pain in the ear" or "was suddenly struck with a pain in the ear." As an example of how mastoiditis was treated in 1840 and the disastrous results obtained in some cases, the following extract from the work of George Pilcher [3] will prove interesting:

"A young man, aged seventeen, complained of pain and immobility of the neck, frequent headache, and a fetid discharge from the left ear, which had continued several weeks. This discharge had been preceded by acute pain, it came on suddenly, and had been very copious from its first appearance, with an offensive smell. He had been deaf in that ear for some months, but did not seek medical assistance until matter flowed from it. The neck was then blistered, the ear syringed, and medicines administered, by which the pain of the ear was relieved; but the neck became more stiff and painful, so that at length he was unable to turn his head in

[1] *Diseases of the Ear*, 2d Amer. ed., 1865, p. 360.
[2] *Ibid.*, Amer. ed., 1853, p. 320.
[3] *Pilcher on the Ear*, Amer. ed., 1843, p. 239.

the least. I found the muscles on the left side rigid and every part of the neck exquisitely sensitive, but especially near the atlas, and the least jarring motion caused agony. Notwithstanding he represented his sufferings to be continual and his nights very frequently dreadful, his appetite was good and his strength sufficient to enable him to pursue his employment as a compositor in a printing-office. His countenance, however, was extremely pallid and anxious; pulse 90, and feeble. From these symptoms I inferred that he labored under otitis, which had probably been communicated to the bony structure of the internal ear and other parts in the base of the skull; the prognosis was, therefore, unfavorable. Leeches, fomentations, mercurials, and gentle aperients produced intervals of relief. The malady, however, evidently continued to advance, and at length he could no longer support his head without the aid of his hands nor separate his teeth more than ½ inch. He lived in continual terror of moving, and felt, he said, as if his neck were broken. Considerable distortion of the cervical vertebræ was now apparent; the spinous process of the dentata projected much toward the right side, more than 1 inch from the mesial line, and a slight crepitus could be felt upon passing the finger from the first to the second vertebra. On either side of the atlas there was an unusual fulness, but the central part appeared depressed and it yielded to gentle pressure, which often seemed to produce a flow of pus from the diseased ear. A burning pain came on in violent paroxysms, extending, as he described it, all over the inside of his head; it was excited by the least motion, and while it lasted he raved like one laboring under phrenitis; its duration varied from half an hour to two or three hours. He became hectic and extremely emaciated; obtained no sleep without narcotics, which often procured a night's complete rest. A succession of blisters were applied, but without benefit. In this miserable manner he proceeded, with little variation, for six weeks, when, while his nurse was attempting to assist him in raising his head to move his pillow, he suddenly became paralyzed in every limb. His intellect remained perfectly clear and his pulse continued about 90; his respiration was not remarkably affected, but he passed a

motion without his knowledge. He died calmly, about six hours after the occurrence of this perfect paralysis.

"*Inspection of the Body.*—On handling the neck, pus flowed abundantly from the ear. Upon removing the calvarium we found the dura mater rather adherent and more fluid than usual in the arachnoid cavity. The brain appeared healthy except that it was somewhat injected. No other signs of disease existed within the skull, but pus poured from the spinal canal through the foramen magnum. When the muscles of the neck were dissected those of the left side were found degenerated and pervaded by veins of curdled pus. The atlas was tilted on one side and very movable. On detaching it from the occiput we discovered that portion of the mastoid process, including the digastric fossa, and that part of the occipital bone connected with the left condyle partially destroyed by caries. The left occipito-atlantoid ligaments were reduced to a pulp and the glenoid surface was denuded of its cartilage and roughened. The processus dentatus was carious and its ligaments were obliterated. The theca connected with the first and second vertebræ was inflamed and surrounded by pus, and the medulla itself broken down and mixed with sanious matter. The ulcerative action had commenced in the articulating surfaces of the atlas and dentata; and an opening existed between the oblique processes of the second and third vertebræ on the right side, which communicated with an abscess among the muscles, and opened by a small aperture into the upper and back part of the pharynx."

Technic.—The instruments required for the convenient performance of the mastoid operation are scalpels, five or six hemostats, a pair of broad retractors, Allport's dilator (Fig. 258), bone-gnawing forceps (Fig. 254), bone-gouges, chisels (Fig. 257), a mallet, two bone-curets (Figs. 253, 256), a steel grooved director, and a silver probe.

While the operation of opening the mastoid is generally performed for liberating the contents of a septic cavity, it should be done under antiseptic precautions. The instruments should be sterilized by boiling them in a 2 per cent. soda solution and the hands of the operator and those of his assistants disinfected in the usual manner. The patient's

hair should be shaved off for a distance of about 2 inches above and behind the ear to be operated upon. The skin covering the field of operation should be disinfected in the usual manner and the auditory canal syringed with warm bichlorid solution. These preparations of the patient for operation are better made previous to giving the ether. If the patient's hair is long it should be covered by a towel wet in bichlorid solution or a rubber cap.

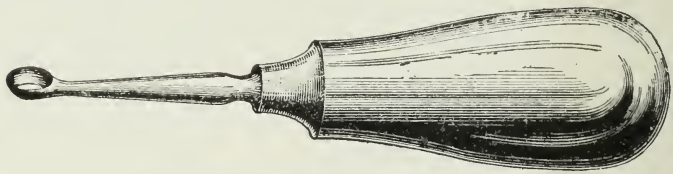


FIG. 253.—McKernon's mastoid curet.

If the drum-head has not been perforated during the course of the disease, it is best to preface the operation by an incision around the posterior periphery.

An incision is made through the skin to the bone from the tip of the mastoid to a point above the helix. The incision should be as close to the insertion of the auricle as

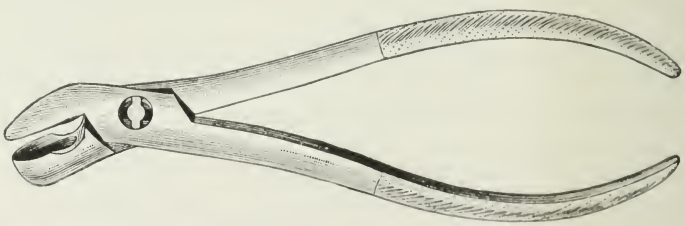


FIG. 254.—Hopkins' rongeur forceps.

possible. In the case of children this incision should be made somewhat deliberately with the edge of the knife rather than its point, so that there will be no danger of thrusting the knife point deeply into a dehiscency of the bone. In the case of adults the tip of the mastoid should be located with the end of the index-finger of the left hand and the point of the knife thrust at once through skin and periosteum into the bone. Maintaining firm pressure with

the knife point against the bone, the incision is continued upward around the auricle to stop at a point just short of the temporal artery, the exact position of which has previously been located with a finger-tip of the left hand. If the incision is made in this manner it will cut through the periosteum the entire length of the cut, and facilitate stripping the periosteum from the bone without tearing it.

After the incision has been made several little spurting arteries will require clamping with hemostats by the operator or his assistant, and if the parts are brawny and swollen there will probably be a somewhat profuse venous hemorrhage from all parts of the wound. This can be controlled by the application of hot water or may be disregarded until the periosteum is separated from the bone, as it will cease after Allport's dilator has been applied. If the mastoid process is large it may be desirable to secure additional

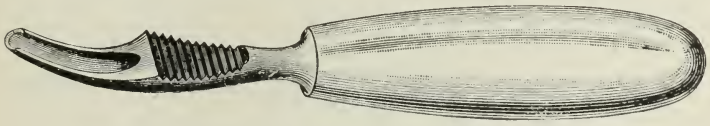


Fig. 255.—Randall's hand-gouge.

space by making an incision about 1 inch in length at right angles to the original incision from the center of the auditory meatus toward the occipital protuberance. The presence of this second incision not only secures additional space, but has the advantage that the two posterior triangular flaps fall away from the bone and do not require the use of a retractor to hold the wound open.

The periosteum should be separated from the bone with every precaution to avoid tearing it. It peals off from the bone very readily except when the mastoid is rough, and especially at the tips of the mastoid, where the sternocleidomastoid muscle is attached.

Randall's hand-gouge (Fig. 255) makes a very good periosteum elevator. From the smoother portions of the mastoid the periosteum is very quickly and readily pushed and pried loose, but the tip of the bone requires some skill and patience, as the attachments of the muscle are tough

and the surface of the bone rough and uneven. However, if the concave surface of the gouge is kept closely in contact with the bone and the edge of the chisel is sharp, it is possible to remove the periosteum even in this locality without tearing it.

As soon as the periosteum has been separated from the bone Allport's dilator (Fig. 258) is inserted in the wound. As the instrument is opened by means of the thumb-screw the wound becomes widely dilated and the pressure on the soft parts is sufficient to cause all hemorrhage to cease. Two of these instruments should be used; one at each extremity of the wound. The blunt hooks of the instruments should be kept closely in contact with the bone, as the blades are opened in order to grasp all of the tissues efficiently. However, as previously mentioned, if an incision is made at right angles to the original incision, no dilator and probably not even a retractor will be required to expose the entire surface of the mastoid during the operation.

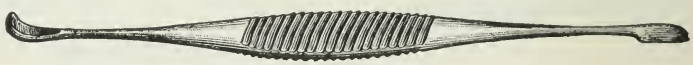


FIG. 256.—Gleason's double-end bone-curet with curved tip.

When the surface of the mastoid has been uncovered by the separation of its periosteum, it should be inspected carefully with a probe or grooved director for the presence of any sinus or soft spot leading through its cortex to an abscess-cavity. If such a sinus is found it should be explored with a probe passed in the direction of the antrum and the softened cortex of the mastoid carefully scraped away with a curet (Fig. 253). The curet should be used in such a manner as not to endanger the lateral sinus (Figs. 259, 260).

When the sinus has been sufficiently enlarged it may be found that the entire mastoid is a cavity filled with pus and pulpy granulations, every trace of cellular structure having disappeared. This condition of affairs is most likely to occur in large-celled pneumatic mastoids. Under such circumstances the bony overhanging edge of the external cortex of the mastoid should be clipped away with the forceps (Fig. 254) until the abscess-cavity is thoroughly ex-

posed. The pulpy granulations and débris should then be scraped away with the curet until firm normal bone is encountered. However, the curet should be used with gentleness and judgment in positions where the lateral sinus is likely to be encountered, so as not unnecessarily and unexpectedly to expose or even wound this important vessel. The position of the mastoid antrum should also be located with a probe and when working toward it with the curet

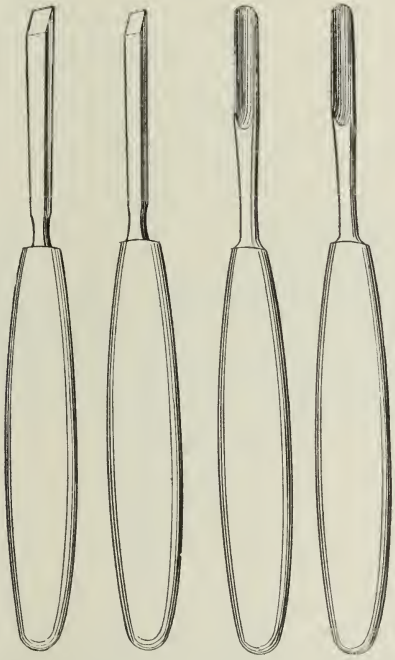


FIG. 257.—Whiting's mastoid chisels and gouges.

the position of the aquæductus Fallopii (Figs. 173, 237, 239) should be borne in mind, so as to avoid danger of cureting away a part of the facial nerve.

The floor of the mastoid antrum lies just behind and below the spina suprameatum (Fig. 260), in a direction parallel to the bony meatus. If the operator is in doubt as to the direction of the bony meatus it is permissible to insert a probe

between the bony and membranous meatus so as to be absolutely sure as to the proper direction in which to continue the use of the curet or the chisel. Not infrequently after the abscess-cavity in the mastoid has been cleansed there will be found only a small opening into the antrum, if, indeed, any exist large enough to permit the passage of a probe. The bone in this locality is sometimes soft enough to permit it being readily scraped away with the curet. Under some circumstances Randall's hand-gouge is a most useful instrument. The index-finger of the right hand should be held close to the cutting edge to prevent the instrument slipping, then, by slightly rotating the instrument as its edge is pressed firmly against the bone, even the hardest bone may be partly bored, partly gouged out, until at length the antrum is reached. The operator can assure himself

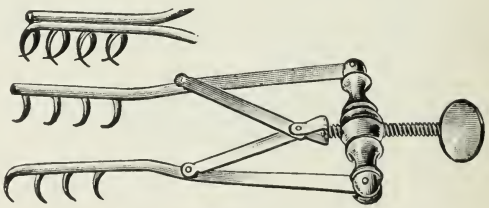


FIG. 258.—Allport's dilator.

that it is certainly the antrum that has been opened by passing a probe forward and outward through it into the attic. Fluid syringed into the antrum should appear in the meatus unless the aditus or attic is filled with granulations or the drum-head is not perforated. Should this be the case they should be removed by means of a small curet (Fig. 229, *a*), being careful not to dislocate the incus during the procedure. However, should it prove impossible to syringe from the attic into the meatus, no especial harm need be apprehended, as the passage will be probably established within a short time.

Formerly, when the main abscess-cavity had been thoroughly cleansed and a free communication established between the mastoid antrum and the external wound the operation was considered complete. The larger porportion

of cases operated on in this manner make an uneventful recovery and the resulting scar or deformity is inconspicuous. However, there are often a few cellular spaces above the meatus and in the root of the zygomatic process, so that in cases where the operation results in the formation of a discharging sinus the fistula frequently leads to one of the cell-spaces that was not thoroughly opened at the time

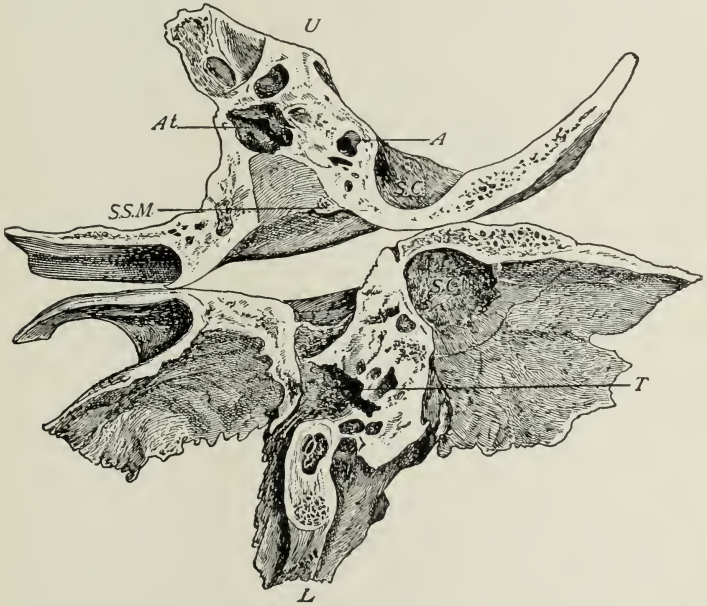


FIG. 259.—Horizontal section through a right temporal bone below the spina, showing an extreme anterior and superficial position of the sigmoid sulcus, thus bringing the lateral sinus within 1.5 mm. of the bony surface at the operating point and rendering the ordinary mastoid operation impossible. At a position somewhat above the operating point the sulcus is less than ½ mm. from the bony surface: *U*, Upper, *L*, lower portion of the specimen; *S.C*, sigmoid sulcus; *T*, tympanum; *At*, attic; *A*, small antrum; *S.S.M*, spina supra-meatum. (Author's specimen.)

of the operation. Hence the disposition has been to make the bone wound larger than formerly by chiseling away the overhanging edge of bone above and behind the meatus and also the root of the zygoma. Not only are all cell-spaces, if present in this locality, by this method of operating removed, but the mastoid antrum is thoroughly

exposed and becomes the bottom of a shallow cup-shaped cavity from which exuberant granulations can readily and thoroughly be scraped away. The flatter wound is readily cleansed and dressed after the operation and the healing process somewhat shortened.

In the tip of most mastoid processes there is usually a large cell even when the bone is of the small-celled diploëtic type (Figs. 249, 250). It is best in all cases, therefore, to remove the cortex of the mastoid tip and thoroughly expose this large cell if it be present to inspection. If it be filled with pulpy granulations these should be scraped away until the normal bone beneath has been thoroughly cleansed and exposed. In a small percentage of cases abscess of the large cell in the tip of the mastoid results in *perforation* through the median wall and the gravitation of pus into the digastric fossa and beneath the sternocleidomastoid muscle into the deeper tissues of the neck. Under these circumstances it is necessary to remove the entire tip of the mastoid and thoroughly expose the abscess-cavity. The incision through the skin should be lengthened along the anterior border of the sternocleidomastoid muscle and the attachment of the muscle to the end of the tip and median surface of the tip of the mastoid severed with scissors held as close to the bone as possible, after which the tip is very readily removed with the rongeur forceps (Fig. 254). Instances in which the median surface of the large cell at the tip of the mastoid has been perforated, with the result of the gravitation of pus into the digastric fossa and the deeper tissues of the neck, were first described by Bezold and are hence frequently referred to as Bezold cases. It was a neglected case of this type that is quoted from Pilcher. Cases of this type are characterized by a brawny swelling below and behind the mastoid, and movements of the neck are extremely painful to the patient. Not only is it necessary to remove the entire tip of the mastoid in such cases, but the abscess-cavity in the tissues of the neck should be thoroughly laid open by a free incision through the skin. The sternocleidomastoid is attached not only to the tip of the mastoid process, but to the base of the skull posteriorly, and severing its attachment to the mastoid does not appar-

ently impair its functions. However, except in Bezold cases, it is manifestly not absolutely necessary as a mere matter of routine to remove in all cases the entire tip of the mastoid and expose the digastric fossa.

If no softened spot or sinus is found upon the surface of the mastoid bone after denuding it of its epithelium it will be necessary to make an opening by means of the mallet and chisel. For this purpose the spina suprameatum or spine of Henle should be carefully located and preserved

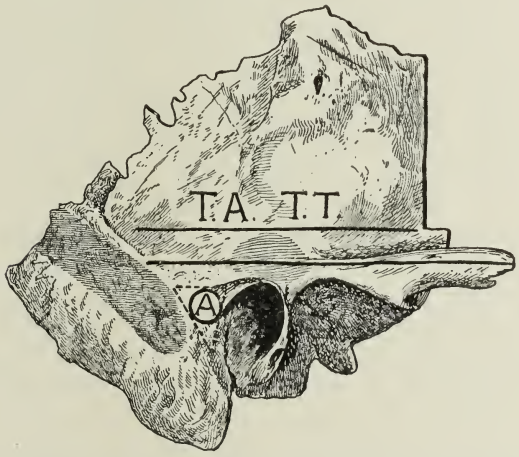


FIG. 260.—Lateral surface of a right adult temporal bone, showing superficial landmarks. The shadow indicates the position of the lateral sinus: *A*, Antrum; in the triangle of MacEwen immediately in front is a well-developed spina suprameatum at the posterior superior border of the meatus; *T.A*, *T.T*, upper surface of the tegmen antri and tegmen tympani. In some specimens the middle cerebral fossa extends as low down as the dark line immediately above the meatus, and hence chiseling cannot be carried above the level of this line without danger of entering the cranial cavity. (Author's specimen.)

during the subsequent procedures of the operation to serve as a landmark. Some portion of the mastoid antrum will be found at a depth of from 12 to 22 mm. in a direction parallel to the meatus, immediately behind the spina suprameatum, in a space called the suprameatal or triangle of MacEwen (Fig. 260). If at a depth of 15 mm. or about $\frac{3}{5}$ inch when chiseling through dense bone the antrum is not opened, the operator should proceed with great caution to avoid injuring the facial canal or entering the cranial cavity, as the

antrum may be small and easily overlooked. In some instances (Fig. 259) the lateral sinus is much further forward than is indicated by the shadow (Fig. 260), and to avoid the danger of injuring it the operator should keep as close to the meatus as possible when working his way toward the mastoid antrum with a chisel or curet. In some instances, where the drum-head and ossicles are partially destroyed, a silver probe with its tip bent at a right angle may be carried through the canal into the vault of the tympanum and held in such a position as to serve as a guide. If the chiseling and cureting be continued in the right direction within the triangle of MacEwen, that is, parallel to the canal and a little upward, there is little danger of wounding any important structure before the probe is encountered. When chiseling through sclerosed bones (Fig. 251), even though no cell structure nor pus, but only softened bone in the region of the antrum is encountered, the relief of all mastoid symptoms usually follows the operation.

As the lateral sinus is sometimes very superficial and displaced far forward toward the meatus, the cortex of the mastoid is most safely removed by inserting a moderate-sized gouge immediately beneath the spine, and keeping as close to the meatus as possible, chiseling a long strip of bone down to the mastoid tip. It may be advisable to chisel a second groove parallel to the first. The depth of the grooves should be increased if necessary until cellular tissue is encountered, when the chisel may be discarded for a narrow curet (Fig. 256), and the cellular tissue removed, all overhanging edges of the cortex being cut away with the rongeur as the operation proceeds until the mastoid process has been thoroughly eviscerated and the antrum converted into a shallow cup-shaped cavity.

After-technic.—After the operation is completed the auditory meatus and wound should be irrigated freely with warm sterilized water. It is not advisable to use solutions of corrosive sublimate for this purpose while the patient is under ether, as the fluid may run through the Eustachian tube into the throat and an unknown quantity be swallowed. If necessary one or more sutures should be used to hold the auricle in position, the wound and auditory canal lightly packed

with iodoform gauze, and a roller bandage applied over sterilized gauze and cotton.

Twenty-four hours after the operation the dressing should be removed from the wound and the parts carefully inspected. The parts should then be thoroughly douched with a 1 : 1000 bichlorid solution, the wound again packed lightly with iodoform gauze, and sterilized gauze, cotton, and roller bandage applied. If the wound be packed too firmly with the iodoform gauze during the first few days following the operation there is danger of injury of the facial nerve, with resulting transient paralysis of some of the facial muscles; later on the wound may with advantage be packed more firmly. In some cases the wound does better if, after thoroughly cleansing, it be dusted with boric acid and packed either with sublimate or sterilized gauze. This is more especially the case if the lips of the wound appear sluggish and the exposed bone does not quickly cover itself with granulations. The presence of edema in the superficial tissues about the wound may render advisable the use of a wet sublimate dressing for from twenty-four to forty-eight hours. Sometimes exuberant granulations on the superficial edges of the wound will require removal with the curet or scissors, as the wound requires to be kept open until firmly healed from the bottom, a result that usually requires from three to four weeks.

Usually recovery from a mastoid operation is uneventful. Pain and sleeplessness on the night following the operation may require the use of a small dose of chloral and bromid of sodium or even an opiate. Usually the temperature is practically normal and the patient entirely comfortable on the morning following the operation. If the evening temperature for the first three or four days reaches 100° or even 101° F., it need occasion no anxiety. When the temperature remains normal for one or two days the patient may be allowed to sit up and move about in his room.

Persistent pain and sleeplessness with high temperature following the operation may be due to a slight attack of local periostitis or to the fact that all the foci of inflammation in the mastoid bone have not been reached by the chisel.

Accidents Occurring During the Mastoid Operation.—The middle cranial fossa may be opened, the posterior cranial fossa may be opened, and the lateral sinus exposed or wounded. One of the semicircular canals may be penetrated. The facial nerve may be wounded or divided.

Occasionally the middle cranial fossa extends downward to a level scarcely more than $\frac{1}{4}$ inch above the meatus (Fig. 260). It is better, therefore, not to do any deep chiseling in this locality until the mastoid antrum has been located. After this has been accomplished and the cavity thoroughly exposed, it is, of course, easy to locate the exact position of the floor of the middle cranial fossa by means of a probe in contact with the tegmen or roof of the antrum. After this has been explored with the probe it is easy without the slightest danger of entering the middle cranial fossa to remove the superficial bone, including the spina suprameatum above and behind the meatus, in order to secure a flat wound. However, if the middle cranial fossa be opened and the dura exposed, it is not usually a very serious accident, as the dura ordinarily granulates like the other portions of the wound, providing the operation is done with antiseptic precautions. It is perfectly justifiable when softened bone is found in the vicinity of the tegmen to thoroughly remove the diseased bone even if by so doing the dura is exposed, as by this procedure a small extradural abscess may be opened whose presence otherwise would not be suspected. Should pus be located between the skull and the dura the opening in the bone should be made sufficiently large to secure ample drainage, but exploration with the probe between the bone and the dura should be undertaken with extreme caution and gentleness, because the dura ordinarily attaches itself about such an abscess-cavity to the base of the skull, thus isolating the suppuration from the rest of the dural surface and preventing a general infection. However, considerations of this kind should not be allowed to interfere with opening the skull sufficiently to secure ample drainage. If the collection of pus be small and the mastoid wound flat, it probably will not be necessary or desirable to insert a gauze drain between the bone and the dura.

Opening the Posterior Cranial Fossa and Wounding the Lateral Sinus During the Mastoid Operation.—In diploëtic and small compact mastoid bones the lateral sinus often occupies a position more anterior and superficial than is normally the case. In the bone shown in Fig. 259 a careless operator might readily expose and open the lateral sinus with the chisel. In very rare instances the sinus is not covered by bone at all, but lies immediately beneath the skin and might be freely opened by the first stroke of the knife. However, even in extreme cases of anterior position of the lateral sinus, there is usually a sufficient space of comparatively soft bone between the hard bone covering the sinus and that of the meatus for a careful operator to work through safely to the antrum with a curet or gouge. The position of the lateral sinus is often apparent after the cellular tissue has been cureted away, a distinct oval elevation of hard bone gradually shaping itself into view. This elevation is the hard bony wall of the sigmoid fossa in which the lateral sinus lies. Should the bone in this locality be carious and soft it should be scraped away with the curet and the sinus exposed, because extradural abscess is somewhat common in this locality. When the lateral sinus is torn or cut during a mastoid operation it does not spurt like an artery, but a gush of blood wells out from the wound, pulsating with each heart-beat as it flows. The lightest pressure of the finger upon the bleeding sinus causes the hemorrhage to cease.

When the lateral sinus is accidentally wounded during a mastoid operation a small piece of iodoform gauze should be placed on the sinus and held in position by the finger of an assistant and, if possible, the operation completed. The wound should then be firmly packed with iodoform gauze in such a manner as to control the hemorrhage and a firm roller bandage applied. The dressing should not be disturbed unless absolutely necessary before the third or fourth day. At this time, if the packing over the sinus is *slowly* and *gently* removed, in all probability the hemorrhage will not reappear. Cases in which the lateral sinus has been accidentally wounded generally do well and make an uneventful recovery. However, it is wise during the first few

days to keep such cases under careful observation lest the bandage be displaced and a hemorrhage recur.

Opening the Horizontal Semicircular Canal and Wounding the Facial Nerve.—The position of the horizontal semicircular canal and the facial nerve is shown in Figs. 173, 176, 239, 240, 242, and 259. The aural portion of the facial nerve may be divided into a horizontal and a vertical portion (Figs. 173, 176, 239). The horizontal portion is embedded in a ridge of bone just above the oval window. The horizontal semicircular canal lies just above posteriorly. Both of the sestructures are embedded in ridges of extremely hard bone. These ridges can frequently be seen in the radical mastoid operation as soon as the attic is well exposed, and hence the exact position of the nerve located. The simple mastoid operation, even when it is sufficiently complete to convert the antrum into a shallow cup in the bottom of the bone wound, does not expose the bony ridges containing the horizontal semicircular canal and the horizontal portion of the facial nerve. However, these structures lie so high up and so far forward that there is little danger of injuring them, except by a careless operator. Ordinarily the ridges of bone containing the horizontal semicircular canal and the horizontal portion of the facial nerve are sufficiently hard and thick to offer great resistance to an instrument, but occasionally the bone is very thin over the horizontal part of the facial nerve or may in part be lacking, so that the nerve lies just beneath the mucous membrane. Hence, if at the close of a simple mastoid operation the aditus and attic are found to be full of exuberant granulations and the small curet (Fig. 229, *a*) is used to remove them, it should be employed with great gentleness when scraping the inner median wall of the aditus.

It is, however, the vertical portion of the nerve that is most liable to injury during a mastoid operation. Because of the oblique position of the membrana tympani the annulus approaches in some instances as close to the nerve as $\frac{1}{2}$ mm. at a position opposite the malleus tip. The operator, therefore, should observe considerable caution in removing much bone in this locality.

When the bone forming the facial canal is necrosed it is

difficult to avoid injuring the nerve during its removal, and hence, if the nerve is partially paralyzed before an operation, it is well to caution the patient that the operation may fail to relieve this condition or even make it worse. A simple bruising of the nerve during a mastoid operation is followed by transient paralysis of the muscles of one side of the face. The paralysis is usually worse in the muscles of the lower portion of the face because that part of the face is supplied by the more superficial fibers of the nerve. Cases of this kind and paralysis resulting from too tight packing of the mastoid wound almost invariably end in complete recovery. It is stated that the nerve may be completely severed without causing permanent facial paralysis.

INTRACRANIAL COMPLICATIONS OF OTIC DISEASE

These are pachymeningitis or subdural abscess, leptomeningitis, serous and purulent; cerebral and cerebellar abscess; and thrombosis of the sinuses.

Subdural or Extradural Abscess.—Pachymeningitis is an inflammation of the dura mater, also called external meningitis and perimeningitis. Generally it is the result of infection from caries. Fortunately, under such circumstances, the dura generally forms adhesions around the carious area of bone and thus prevents the spread of the infection. The disease then becomes a subdural abscess. The usual sites of subdural abscess following aural suppuration are the groove for the lateral sinus and the superior surface of the petrous bone. Such collections of pus can sometimes be located and evacuated by surgical intervention. Cases of spontaneous evacuation through the middle ear have been reported.

It is not very unusual during a mastoid operation to open such an abscess when removing carious bone with a curet. When the dura is thus exposed a probe should be used with great gentleness in order not to break up any adhesions that have formed between the dura and bone about the abscess-cavity. At the same time the amount of bone removed should be sufficient to permit ample drainage from the infected dural surface, which is usually covered by gran-

ulations. The necessity for exposing a considerable area of dura mater by cureting away carious bone need occasion the operator no uneasiness, as the dural surface granulates and heals with the rest of the mastoid wound.

Leptomeningitis is an inflammation of the pia and arachnoid in contradistinction to pachymeningitis, which signifies an inflammation of the dura; although, as ordinarily employed, the word meningitis has practically the same significance as leptomeningitis, which may be either serous or purulent; general, involving the brain and cord, or local, involving, for example, only a portion of the convex surface of one side of the brain.

The avenues of infection in otic leptomeningitis are the tegmen, the sigmoid sinus, the carotid canal, the labyrinth, the facial canal, and the lymphatics or blood-vessels. It generally occurs as the result of caries or necrosis.

Serous leptomeningitis begins as a general hyperemia of the pia and arachnoid, followed by a serous exudation. The dura and the ventricles become distended by the exudate with resulting pressure symptoms.

Slight cerebral irritation, especially in children, probably meningitis, frequently accompanies acute inflammation of the middle ear. The symptoms are localized headache referred to the temporal or occipital region, which may be tender on percussion. Morning and evening fever is sometimes present and, in infants, convulsions. These symptoms may disappear within a short time as the result of purgation with calomel, bromid of potash, and an ice-cap, or the pulse may become rapid, the temperature rise, the pupils cease to react to light, and hebetude with loss of consciousness may occur. In a boy about fourteen years of age, seen at the Philadelphia Hospital, who presented these symptoms on the fifth day of a purulent otorrhea, immediate relief followed the withdrawing of 1½ ounces of cerebrospinal fluid by lumbar puncture.

Lumbar puncture is performed as follows: The patient either sits up or lies upon the side, with the back arched and the knees flexed against the abdomen. The spine of the fourth lumbar vertebra should be located (a line drawn from one posterior superior spine of the ilium to the other passes

across it) and the puncture made ½ inch to one side, at the level of its lower end. The needle should be inclined at an angle of about 45 degrees to the surface of the skin, and should be thrust in a distance of from 2½ to 3 inches. The most scrupulous asepsis must be observed. The spinal fluid flows readily, either in a stream when the pressure is high or drop by drop if it is normal. In purulent meningitis it is cloudy and contains pus-cells; in tuberculous meningitis it is usually clear; in cerebral hemorrhage it may be bloody, but as admixed blood may be due to the injury of a vessel by a needle, the diagnosis should be made with caution. The quantity obtained varies from 2 or 3 to 80 or 90 ccm.—*i. e.*, from a few drops to 3 fluidounces.

Purulent Leptomeningitis.—In purulent meningitis the exudate becomes cloudy and mucopurulent in appearance from the presence of leukocytes. The bacteria present vary and are usually those found in the otorrhea that has caused the condition.

Pathology.—The vessels of the pia and arachnoid are infected and the membranes become cloudy. A serofibrinous or purulent exudate distends the dura or may exist only in patches. The cerebral membranes may be involved either as a whole or in part. In severe cases those of the spine are affected as well. The brain or cord may be softened in places or, as Ander's states, no gross lesions, either of meninges, brain, or cord, even microscopic, are found post mortem in many cases presenting the clinical picture of meningitis.

Symptoms.—The temperature is usually from 101° to 105° F., and exhibits but slight variation during the day and night. There are severe headache, photophobia, vomiting, and localized or general convulsions. Delirium is common in young subjects, but in adults the patient is at first wakeful, but slowly passes into a condition of fatal coma. Paralysis of the pupil, strabismus, and ptosis are the most frequent forms of paralysis present.

There is often retraction and fixation of the head. Reflexes are at first increased and later diminished or absent. There is hyperesthesia of the skin. The pulse, at first full and rapid, later in the disease is slow, but becomes again

rapid in the last stage. The pupils finally become dilated. There is general paralysis and death, occurring as early as two or three days or the fatal termination may be postponed for some weeks.

Treatment.—Where the symptoms are simply those of cerebral irritation, perfect rest in bed, large doses of the bromids, purgation with small, frequently repeated doses of calomel and salines. Sometimes the local abstraction of blood from the ear by means of leeches and an ice-cap are effectual in checking the attack.

Where lumbar puncture gives relief, it should be repeated as often as deemed necessary. The procedure is of value not only as a method of treatment, but as a matter of diagnosis. The amount of fluid flowing freely through the needle indicates the degree of pressure, and the microscope will disclose the presence of pus and the bacteria causing the infection.

As purulent leptomeningitis is invariably fatal unless checked in time, surgical measures, to be of value, must be instituted early. When there is no doubt as to the diagnosis the mastoid antrum should be opened, and if the amount of disease met with is not sufficient to account for the symptoms, the cranial cavity also, in search of an extradural abscess. Even if no pus be found, the opening into the cranium with the consequent local depletion and relief of tension is the best possible treatment and has been followed by recovery in some severe cases.

Abscess of the Cerebrum and Cerebellum.—Abscesses of the brain following otitis are probably invariably located on the affected side. They may be single or multiple. It is the white substance that is generally involved. The bacteria found in the pus are various, generally those found in the discharges of the ear that has been the cause of the infection. Saprophytes or the micro-organisms developing in putrid material are sometimes present.

The disease is generally the result of chronic purulent otitis and necrosis. A localized pachymeningitis as the result of adhesions about the necrosed bone prevent the spread of the infection and a subdural abscess is formed, which in turn infects the brain substance.

Symptoms.—Cerebral abscess may present no symptoms for many months, but at any moment acute meningitis may occur or increased intracranial pressure result in coma and death.

In the early stages the diagnosis is usually not easy. Severe, deep-seated pain and tenderness over the temporal region, optic neuritis, and localized paralysis may be present to a greater or less degree. There may be a sudden rise of temperature lasting for a short time, followed by normal or subnormal temperature, mental dulness, slowness of speech, increasing cachexia and debility, ending sometimes in coma.

The symptoms of *cerebellar abscess* are more obscure even than in cerebral abscess and the diagnosis extremely difficult. Subjects of cerebellar abscess may present absolutely no symptoms, and yet suddenly die as the result of the rupture of the abscess into the fourth ventricle.

Treatment.—Surgical intervention in all cases of intracranial suppuration is the only adequate remedy. As a general rule the cranial cavity should only be entered after removing diseased structures from the middle ear. After the antrum and attic have been cleansed the original skin-wound is enlarged to a sufficient degree by an incision directly backward and the periosteum detached. The groove for the lateral sinus is then cautiously opened by means of a mallet and chisel and the sinus examined carefully for thrombus. If no clot is found the opening into the skull is enlarged by means of the trephine, chisel, or cutting forceps (upward to reach the middle or downward to reach the posterior cranial fossa). While proceeding with the operation it is possible that an extradural abscess may be opened. Under such circumstances free drainage should be secured and the wound dressed. If no such collection of pus is discovered while enlarging the cranial opening a flexible grooved director should be passed in different directions between the dura and the skull in search of pus, and finally the tegmen of the antrum and attic removed, as an extradural abscess is not infrequently located upon this thin plate of bone.

In using a *trephine* for exploration of the cranial cavity one of at least $\frac{3}{4}$ inch should be employed. If the center

pin of a trephine of this size be placed upon the bone $\frac{7}{8}$ inch behind the center of the meatus and $\frac{1}{4}$ inch above Reed's base line (which is an imaginary line passing through the center of the meatus, touching the lower border of the orbit and extending backward to the occipital protuberance), when the disk of bone is removed from the skull it will expose the lateral sinus, which usually is reached more quickly than when the chisel alone is used.

For epidural abscess the center pin of the trephine should be placed upon the skull 1 inch above the center of the meatus. The resulting opening in the skull, if sufficiently enlarged with the rongeur forceps, will enable the operator to explore the surface of the tegmen of the antrum and tympanum. The posterior cranial cavity may be explored by means of a trephine opening if the center pin of the instrument be placed $1\frac{1}{2}$ inches behind the center of the meatus and $\frac{1}{4}$ inch below Reed's base line. Both the middle and the posterior cranial cavities can be explored by means of a trephine opening if the center pin of the instrument be placed $1\frac{1}{4}$ inches behind the center of the meatus and $1\frac{1}{4}$ inches above Reed's base line. As the skull in this position is comparatively thin, it is easy from such a trephine opening with the rongeur forceps to tear away the skull either downward into the posterior fossa or forward into the middle fossa.

If cerebral abscess be present near the surface the dura will bulge without pulsation into the wound. Selecting a spot, a small sterilized hollow needle is carefully inserted in the brain. Should pus escape or the needle yield a fetid odor when withdrawn, the dura is incised and a trocar passed in the required direction. If a definite pus-cavity be emptied of its contents it should be washed out gently with a warm, sterilized, saturated solution of boric acid, a drainage-tube inserted into the tract of the trocar, the wound closed, and a dressing applied. The abscess-cavity should be washed out each day with warm borated water and the drainage-tube shortened at each dressing until the abscess-cavity has closed.

Whiting has devised an instrument which he calls an *encephaloscope*, through which the interior of the abscess-

cavity can be inspected. The instrument somewhat resembles an ear speculum and through it the abscess-cavity can be irrigated and packed with gauze without injuring the normal brain tissue.

An abscess-cavity, having been located by means of a hollow needle or grooved director, the brain tissue is incised, the encephaloscope inserted, and the cavity irrigated. Iodoform gauze, previously saturated with a solution of peroxid (1 : 4 of water), is then gently packed into the cavity and the encephaloscope withdrawn. The packing is changed each day until the abscess-cavity has closed. The wound in the dura is then allowed to heal and the skull wound to fill with granulations and close as in a radical mastoid operation.

If exploration of the middle cranial fossa does not yield results sufficiently definite to account for the symptoms the wound in the skull is enlarged downward sufficiently to permit access to the structures below the tentorium. The exploration in this region should be conducted on the same general principles as in the middle cranial fossa, but, of course, the utmost care should be exercised in the use of the exploring needle.

Sinus Thrombosis.—The lateral sinus may be infected by way of the superior petrosal sinus as the result of attic suppuration. Usually, however, the infection proceeds from the mastoid cells by way of the numerous small veins that reach the sinus through the bone. An early stage of the process is the occlusion of the sinus by a firm fibrinous clot which may extend backward as far as the torcular Herophili or downward into the internal jugular vein. The development of septic bacteria within the clot leads to general septic infection; and if the patient survives long enough, secondary abscesses appear in various organs of the body, septic pneumonia being the most common complication; but it should not be forgotton that sinus thrombosis may produce secondary sinus thrombosis and brain abscess on *the opposite side*. Occasionally sinus phlebitis occurs as the result of the contact of necrosed bone, so that the sinus is easily torn during the mastoid operation, with resulting severe hemorrhage.

Symptoms.—The progress of the disease is exceedingly insidious and the symptoms vague. The most reliable is a sudden great rise of temperature, followed by an abrupt fall at successive intervals as the result of the breaking down of a portion of the clot and the passage of septic material into the general circulation. Unless the thermometer be used every two or three hours during the day the characteristic variation in temperature may readily escape notice. In uncomplicated cases intracranial symptoms, such as severe headache, paralysis, or convulsions, are absent. Sooner or later symptoms of general sepsis occur—asthenia, emaciation, an ashy hue of the skin, and profuse perspiration. Severe rigors may or may not occur.

A certain number of cases of primary thrombosis recover spontaneously, although it is impossible to state how many die subsequently of secondary cerebral abscess and other sequelæ of the disease.

Treatment.—Early operation if the diagnosis is certain. The only therapeutic measures of value are those which combat the asthenia. Nutritious food, by mouth or rectum, large doses of quinin, and alcoholic stimulants.

When the mastoid antrum has been previously opened the original opening should be enlarged backward and downward, and the dura exposed as far as the occipitotemporal suture. After the sinus has been exposed the presence of a clot may be ascertained by the sense of touch or by inserting a sterilized hypodermic needle. If a thrombus is present pus or foul-smelling blood are usually withdrawn, but if the channel is normal, fluid blood alone enters the syringe.

To remove an infectious thrombus the sinus is freely incised and its cavity emptied by the delicate use of a curet until decidedly free hemorrhage supervenes. The cavity should then be packed with iodoform gauze.

When the clot has extended downward into the jugular vein, as evidenced by tenderness along the anterior border of the sternocleidomastoid muscle and a cord-like structure occupying the position of the vein, the vessel should be exposed, laid open between two ligatures, and the clot removed as from the lateral sinus. Any large tributary vein

should, however, be tied before dividing the jugular. If the operation is performed before secondary abscess or profound systemic infection has occurred it may result in the recovery of the patient.

Facial paralysis or Bell's palsy is a paralysis or paresis of some or all of the muscles supplied by the facial nerve. In the graver form of the disease there is complete immobility of the muscles of expression of the affected side of the face, slight deafness from involvement of the stapedius muscle, unilateral paralysis of the uvula and the palate, and unilateral impairment of the sense of taste at the anterior two-thirds of the tongue, through involvement of the chorda tympani nerve.

Etiology.—The disease may be *central*, as the result of basilar meningitis, tumors or exostoses at the base of the brain, syphilitic lesions in this situation, or aneurysm of the vessels at the base of the brain. Not a few cases are apparently rheumatic and result from exposing one side of the face to a draft, sitting in a damp room, or suddenly chilling the body when overheated. The disease is of interest to the aurist chiefly from the fact that it may occur as a complication in a large variety of middle-ear affections, or as a result of the nerve being bruised or wounded during the course of an operation upon the middle ear, or from packing the wound too tightly after the operation. It should be borne in mind that the facial canal arches backward over the oval window and then descends almost perpendicularly through the temporal bone. As the result of the oblique position of the drum-head the facial canal approaches in some skulls to within 1 millimeter of the annulus, at a position about midway between the floor and the roof of the canal. The pressure of a polypus or an accumulation of epithelium or cerumen on the nerve through the thin bone in this region is sufficient in some cases to produce paralysis of the facial nerve, usually remediable by the removal of the offending body. Generally, however, the facial nerve in its passage through the middle ear is defended by comparatively thick and hard bone. In some instances, however, the bone covering the nerve above the oval window is as thin as tissue-paper, and congenital dehiscences

of the bone of this region are by no means uncommon, so that the nerve in such cases lies almost immediately under the mucous membrane. Such a congenital lack of bone in this position explains the occasional occurrence of facial paralysis as the result of simple non-suppurative catarrh of the middle ear. Suppuration of the middle ear is a common cause of facial paralysis, sometimes so slight that the lack of mobility of the affected side of the face can be detected only by the closest scrutiny; at other times the paralysis is complete and involves all the muscles supplied by the facial nerve on the affected side of the face. Such cases are doubtless the result of pressure on the nerve caused by spreading of the inflammation from the mucous membrane to the bony wall of the facial canal and the sheath of the nerve, and are the more favorable instances of the disease; for after the subsidence of the inflammation and the absorption of the exudation the facial paralysis disappears spontaneously. Facial paralysis occurs during caries and necrosis of the temporal bone if the inflammation and destruction extend to the nerve; but caries of the facial canal is not always accompanied by paralysis, for instances are on record where, as the result of caries, the nerve has been exposed and bathed in pus for months without the occurrence of facial paralysis. Facial paralysis in more than one instance has followed the simple removal of the drum-head and larger ossicles, and is not uncommon as the result of the mastoid operation. Most of these cases ultimately completely recover, sometimes even when there was reason to suppose that the nerve had been completely severed. When working in the neighborhood of the facial nerve some operators are in the habit of directing their assistant to watch for slight twitching of the muscles of the face, and desist immediately should this occur. When twitching of the face occurs under these circumstances it is an indication that mischief has already been done to the nerve, and, unless absolutely necessary, the vicinity of the facial nerve should be studiously avoided during the Stacke and mastoid operations. Many operators are accustomed, when performing Küster's operation, to guard the position of the facial canal with a bent probe or similar device introduced into the tym-

panum through the opening in the mastoid bone. Doubtless this is a useful procedure in some instances, but the use of the probe in this manner is apt to produce a misleading sense of security, and there are reasons for believing that in some instances the injury to the nerve has been done by the slipping of the probe entrusted to the hand of an assistant rather than by the instrument in the hands of the operator. The wound in the bone after a middle-ear operation should be only lightly packed with gauze, especially in the case of children.

Symptoms.—Double facial paralysis is somewhat rare. When it does occur and is complete the face is absolutely expressionless and as immobile as that of a graven image. In a case observed by Tröltsch the cornea was partly dried as the result of ectropion of the lower lid, the under lip hung loosely down, and the chin had to be pushed up in speaking and eating. Facial paralysis sometimes appears quite suddenly, but in many instances there are premonitory symptoms of pain in the side of the head and twitching of the muscles of the side of the face. A patient suffering from complete facial paralysis is unable to wrinkle the brow or close the eyes, although the upper eyelid often descends somewhat during the effort. On account of the paralysis of the orbicularis the puncta lacrimalia drop away from the globe and the eye is constantly suffused with tears, and, being no longer protected from dust and cold by the motionless lids, soon becomes inflamed. The ala nasi on the affected side cannot be distended during inspiration and hence nasal respiration and the sense of smell are impaired on the affected side. The angle of the mouth drops a little and is drawn somewhat toward the unaffected side. While drinking, some of the fluid dribbles from the corner of the mouth; and the food collects between the cheek and the teeth, so that it is necessary while eating to remove it from time to time with the finger. If the cheeks are distended air escapes at the corner of the mouth, and because of the paralysis of the palate-muscles it is usually necessary to employ the Eustachian catheter if the ears require inflation. The hearing is usually somewhat impaired as the result of paralysis of the stapedius muscle, but sometimes becomes

still worse, if care is not exercised, from Eustachian salpingitis resulting from the paralysis of the tubopalatine muscles. When an attempt is made to smile the entire lower part of the patient's face seems to move toward the unaffected side. If recovery does not occur the affected muscles sometimes undergo atrophy, so that the affected side of the face looks smaller than the other. Contractures and spasms of the affected muscles in some cases finally occur, the spasms being clonic in character and not painful. As the result of contracture the angle of the mouth is sometimes drawn upward and the nasolabial fold deepened until at the first glance it would appear as if the unaffected side of the face were the paralyzed one.

In many instances the paralysis of the facial muscles is not complete, the muscles of the lower portion of the face being the ones most affected. In some instances, however, the muscles of the lower portion of the face and those of the forehead as well will be almost completely paralyzed, while the eye can still be completely shut, although with considerable effort. As this form of paralysis is the most common after middle-ear operations, it would appear that the fibers of the nerve supplying the muscles of the lower part of the face and the forehead occupied a more superficial position within the facial canal than those supplied to the orbicularis palpebrarum.

Diagnosis.—In the variety of the disease due to a central lesion the paralysis usually occurs after an apoplectic seizure and other muscles are generally affected besides those of the face. Generally in such cases the muscles of the forehead and the orbicularis palpebrarum are affected to a considerably less degree than those of the other parts of the face, and the electric contractility of the affected muscles is not affected in the slightest degree, no matter how profound the paralysis may be. In a certain proportion of cases the unilateral paralysis of the palate, impairment of the function of taste at the anterior two-thirds of the tongue, and the presence of a disease of the middle ear that is capable of causing a lesion of the seventh nerve are points that will help to clear up the diagnosis. In peripheral facial paralysis it is sometimes possible to determine with a cer-

tain amount of accuracy the portion of the seventh nerve in which the lesion has occurred. If the lesion is above the geniculate ganglion there will be paralysis of all the facial muscles and those of the palate and uvula, with disturbance of hearing; but the sense of taste will be unimpaired, because the chorda tympani nerve enters the facial at the geniculate ganglion. If the lesion is between the geniculate ganglion and the point at which the nerve to the stapedius muscle is given off there will be paralysis of the facial muscles, disturbance of hearing, and impairment of the sense of taste, but the movements of the soft palate will remain unimpaired because its motor fibers are supplied from the geniculate ganglion. If the lesion is situated between the point where the stapedius nerve is given off and the point where the chorda tympani leaves the nerve, the former symptoms will be present, with the exception that there will be no disturbance of hearing; and if the lesion is below the point where the chorda leaves the facial nerve there will simply be paralysis of the muscles of one side of the face. In order that the above should be practical for purposes of diagnosis it is necessary that the lesion should be sufficiently great to involve all the fibers of the nerve, which, of course, is not always the case.

The *prognosis* depends upon the nature of the lesion producing the facial paralysis. When a portion of the nerve has sloughed away as the result of caries of the temporal bone recovery from facial paralysis is not to be expected, and where the nerve has been completely divided during a middle-ear operation complete recovery rarely occurs. Cases of paresis of the facial nerve and cases where only a part of the muscles of the face are involved usually result in complete recovery. The development of contractures and spasms is a most unfortunate event, as no cases where this occurs recover from the facial paralysis; and considerable deformity of the face is usually the result of the contractures and spasms. When the electric excitability of the nerve and muscles remains unchanged spontaneous recovery in from three to eight weeks may be expected, providing the middle-ear disease that produced the lesion of the nerve ceases to be an active factor in the case. In many

cases the excitability of the nerve and muscles to the Faradaic and galvanic currents begins to diminish within a few days of the onset of the paralysis, and is entirely lost at the end of a week or ten days; and this extinction of electric excitability continues until the patient begins to recover. Usually, in such cases, the patient is able to produce voluntary movements of the paralyzed muscles before the nerve begins to react to electric stimuli. The case should not be regarded as hopeless when electric excitability of the affected muscles is entirely lost for a short period; but such cases make a tedious recovery, and a period of from six to nine months usually elapses before a cure of the paralysis occurs.

Treatment.—If diseased, the middle ear should, of course, receive appropriate local treatment. In rheumatic cases and those resulting from disease of the middle ear it is well to place the patient upon full doses of iodid of potassium and an ointment composed of equal parts of mercurial, iodin, and belladonna ointments should be rubbed into the skin over the mastoid and below the ear sufficiently often to keep the parts slightly sore to the touch. After from one to three weeks have elapsed and reaction has set in, it is well to begin the use of electricity, preferably the Faradaic current to the affected muscles, but in some cases better results are obtained from the employment of the galvanic current. A weak galvanic current may be sent along the affected nerve-trunk by placing a medium-sized electrode over each ear (the negative on the affected side), and passing a current between them. The Faradaic current may be applied to the affected muscles by placing a small electrode over them in turn; or the electrode may be passed along a line in front of the auricle in order to reach the fibers of the pes anserinus where they cross the side of the face. The current should be of sufficient strength to produce contractions of the affected muscles, and the sittings should last not longer than ten minutes every day or every other day.

DISEASES OF THE PERCEPTIVE APPARATUS

Diagnosis Between Middle-ear Deafness and that Resulting from Disease of the Internal Ear.—The diagnosis is made from the history of the case and by means of tuning-forks. Sudden deafness without pain is usually the result of impacted cerumen or of disease of the receptive apparatus of the ear. In most cases of long-continued disease of the middle ear the functions of the labyrinth become impaired because of the extension of the disease into the vestibule. It should be borne in mind that there are a few very short rods at the commencement of Corti's organ near the vestibule and that these rods are set in vibration by high-pitched sounds. Hence, when disease of the middle ear has extended from the middle ear into the labyrinth, hearing is greatly impaired for high-pitched notes.

A vibrating tuning-fork with its handle upon the mastoid is heard *longer* in middle-ear disease than if the middle ear were normal. If, however, the functions of the labyrinth are impaired the reverse is the case. A vibrating tuning-fork with its handle upon the vertex or forehead is heard best in the deafer ear in cases where the functions of the receptive apparatus are unimpaired (Weber's method). The sound of a vibrating tuning-fork is heard longer when its tines are at the auditory meatus than when the handle is pressed upon the mastoid (Rinne's test, positive) by normal ears and by ears in which deafness is mainly the result of impairment of the functions of the receptive apparatus. Rinne's test is negative in cases where the deafness is due to impacted cerumen or disease of the middle ear.

It must not be supposed that tests with the tuning-fork are infallible; for example, in cases in which the capsular ligament around the stapediovestibular joint has become stiff as the result of disease, it is easy to understand how the stapes can become fixed in the oval window as the result of a blow on the side of the head or the concussion produced by the unexpected discharge of firearms. Under such circumstances suspension of the function of hearing will result from suddenly increased interlabyrinthine pressure. The symptoms under such circumstances would all

point toward disease of the labyrinth, and yet the hearing may become nearly normal as the result of vigorous inflation of the middle ear by Politzer's method. It is evident that in a case of this kind there was no actual disease of the labyrinth.

Anemia of the labyrinth may be part of a general anemia or due to some local cause affecting the blood supply, such as tumors of the brain, endocarditis, osteosclerosis, or embolism of the auditory artery.

Symptoms.—After profuse hemorrhage from any cause there is tinnitus, vertigo, and nausea as the result of anemia of the labyrinth. These symptoms are made worse by sitting or standing and are decidedly ameliorated by lying down. The same is true of anemia of the labyrinth from other causes than hemorrhage. In anemia of the labyrinth the acuteness of hearing is more or less impaired, both for aerial and bone-conduction.

Treatment is addressed to the general condition of the patient.

Hyperemia of the labyrinth may result from most of the acute infectious diseases, middle-ear inflammation, some intracranial diseases, valvular disease of the heart, the menopause, plethora, gout, alcoholism, quinin, amyl nitrite, salicylic acid compounds, calcium chlorid, the irritation resulting from long use of the telephone receiver, loud noises, vasomotor disturbances, etc.

The *symptoms* are similar to those of anemia, except that *they are intensified by the horizontal position.* The auricle, auditory canal, and drum-head may visibly participate in the hyperemia. Occasionally individuals are encountered in whom a few grains of quinin or salicylate of sodium will produce visible hyperemia of the auricle, canal, and drum-head; also tinnitus, presumably from hyperemia of the labyrinth.

The *treatment* is systemic. The symptoms are made worse by inflation and massage. Relief of tinnitus may be obtained from the bromids or hydrobromic acid, but comparatively large doses (20 to 30 gr. three times a day) are required.

Hemorrhage into the labyrinth may occur as the result of

degeneration of the blood-vessels, traumatism, hyperemia, concussion from explosions, etc.

The *symptoms* are sudden deafness, nausea, syncope, and vertigo, with a tendency to fall toward the affected side.

Prognosis.—If the hemorrhage is small it may be completely absorbed with a restoration of the normal functions of the ear, but should the extravasation undergo fibrous degeneration the partial deafness will be permanent. Tinnitus, vertigo, and nausea, however, will disappear.

Treatment consists in free catharsis and absolute rest in bed. Pilocarpin hydrochlorate may be given in $\frac{1}{10}$-gr. doses twice a day for five or six days or longer if it produces a decided improvement in the aural symptoms. Iodid of potassium should be given in conjunction with or after the use of pilocarpin in 10- or 15-gr. doses three times a day or, if there is a history of syphilis, the dose should be further increased. After the lapse of some months quinin may be given slightly above the tonic dose to increase the supply of blood to the labyrinth and promote absorption if deafness and tinnitus still persist.

Significance of a Discharge of Blood from the Internal Ear.—Occurring after traumatism a discharge of blood from the internal ear through the tympanum and external auditory canal indicates fracture of the base of the skull. An effusion of blood may occur within the labyrinth and cause complete disintegration of this organ.

Concussion of the Labyrinth.—The *symptoms* are sudden deafness following concussion or a blow, without visible local injury. Tinnitus is usually present. The prognosis is unfavorable, but $\frac{1}{16}$ to $\frac{1}{8}$ gr. of pilocarpin should be injected subcutaneously each day until symptoms of weakness of the patient occur or it is manifest that the treatment is unavailing.

Hysteric deafness is a somewhat rare symptom occurring in hysteric women. The deafness may be complete, lasting for several hours or days. Treatment is the same as for other hysteric conditions.

Syphilis of the Internal Ear.—Plastic exudations may occur within the labyrinth similar to those occurring in plastic iritis. The disease is ushered in by loud subjective

noises, deafness soon following. There is usually a noticeable disturbance of the patient's gait and he complains of constant dizziness. The prognosis is not altogether unfavorable if vigorous antisyphilitic treatment is begun early. One case observed by the writer at the Medico-Chirurgical Hospital made a complete recovery, although when first seen some months after the onset of the disease the vertigo was present to the extent that the man staggered as if intoxicated.

Metastasis may occur in parotitis or mumps to the labyrinth, with an exudation of a plastic material, the symptoms being deafness, tinnitus, and vertigo. If the affection is treated early, before the organization of the plastic material, with hypodermic injections of pilocarpin the prognosis is not altogether unfavorable.

"**Méniere's disease**" is a name given to a group of symptoms which may be caused by various affections of the labyrinth, the acoustic nerve, or the central nervous system, usually apoplectiform in character. There are sudden loss of hearing, tinnitus, and vertigo to such a degree often that the patient is unable to maintain his balance and falls to the ground.

Usually the more alarming symptoms pass away within a few days, leaving, however, some deafness, tinnitus, and vertigo, which may remain for years, the deafness gradually getting worse until it is complete.

Treatment.—After the subsidence of acute symptoms iodid of potassium may be administered in doses of from 5 to 15 gr. three times a day and compound iodin ointment may be rubbed into the tissues about the ear. A hypodermic injection of pilocarpin, $\frac{1}{16}$ to $\frac{1}{12}$ gr., should be given each day. It should be borne in mind that the use of this drug is not unattended by danger, and inhalations of ammonia or the administration of a stimulant may be necessary during the sweating stage to maintain the heart's action.

Quinin, in small doses three times a day, is recommended by some authorities, the statement being that its use at first *increases* the disagreeable symptoms, but is followed by their amelioration.

Primary acute labyrinthitis has been described by Politzer and Voltorini, but the disease is very rare.

Panotitis, as the result of scarlatina, diphtheria, or variola, is not so very uncommon. The affection, which generally begins as an acute inflammation of the middle ear, extends to the labyrinth or both parts of the ear may be attacked simultaneously. The course of the disease is very rapid and it ends in complete destruction of the organ of hearing. Its sequelæ may be caries of the bone and chronic suppuration of the middle ear.

Symptoms.—There is high fever, eclampsia, delirium, and sometimes loss of consciousness lasting for days. There is severe tinnitus and vertigo if the patient attempts to raise the head from the bed. A profuse discharge of pus pours from the meatus. Deafness is soon complete.

Treatment.—As the disease is generally the result of infection in scarlet fever, diphtheria, or variola, the internal treatment is that suitable to these diseases. Should the patient's condition admit, pilocarpin may be given hypodermically or by the mouth. The middle ear should be cleansed twice a day by syringing with corrosive sublimate (1 : 1000), the ear dried, and powdered boric acid and acetanilid (equal parts) insufflated by means of the powder-blower.

FORMULAS

DETERGENT WASHES AND REMEDIES USED TO CLEANSE MUCOUS MEMBRANES

1. ℞ Sodii bicarbonatis,
Sodii biboratis, āā ℥j;
Acidi carbolici, ℥ss;
Glycerini, f℥j;
Aquæ, q. s. ad. f℥iv.—M.
Sig. Add to 1 quart of water and use as a wash.

This is a modification of the celebrated "Dobell's solution," and is entirely bland and unirritating to mucous membranes. It may be used either as a spray to cleanse the mucous membrane of the nose, throat, and larynx or may be prescribed as a wash for the patient's use at home. When used as a nose-wash by the patient it should be at a temperature of about 100° F.

2. ℞ Sodii bicarbonatis,
Sodii biboratis, āā ℥j;
Sodii salicylatis, gr. iij;
Menthol,
Thymol, āā gr. j;
Glycerini, f℥j;
Aquæ torridi, f℥iv.—M.
Sig. Add enough water to make 1 quart and use with an atomizer or as a nose-wash.

This formula yields a wash nearly as unirritating as Dobell's solution, and it has not the objectionable odor of carbolic acid. The concentrated wash is sufficiently antiseptic to preserve small anatomic specimens indefinitely, and the diluted wash will preserve them for a considerable length of time. The solid ingredients of the wash may be compressed into a tablet of such size that one added to 4 tablespoonfuls of water will make a wash of the requisite concentration. Under such circumstances borax should be substituted for the glycerin of the formula in sufficient quantity to yield a wash of a specific gravity of 1020, because a wash of a much greater or less specific gravity than 1020 is more or less irritating to the nasal mucous membrane. These tablets

produce a solution less irritating than the well-known Seiler tablets and do not become so hard with age.

Both Dobell's solution and the wash, the formula of which is given above, should be compounded at least three or four days before being used. During this time carbonic acid gas escapes, and glyceroles and other compounds are formed that render the solutions much more bland and unirritating to the nasal mucous membrane. For this reason it is sometimes convenient to prescribe one of the following proprietary preparations :

3. ℞ Listerin, fʒiii–vj ;
Aquæ, Oij.—M.

According to the manufacturers listerin is the essential antiseptic constituent of thyme, eucalyptus, baptisia, gaultheria, and mentha arvensis, of each 1 part ; especially prepared boric acid, 29 parts ; benzoic acid, 1 part ; rectified spirits, 250 parts ; water, to make 1000 parts.

It is one of the oldest and best known of the proprietary mouth-washes and gargles, and has been extensively used as a spray or douche for the nose. As an antiseptic a 25 per cent. solution of listerin in water is more than equivalent to a 5 per cent. solution of carbolic acid and is infinitely more pleasant to taste and smell, and is said to be non-toxic to the extent that listerin may be taken internally in teaspoonful doses three or more times a day. Hence twenty years ago attempts were made to substitute listerin, or what were supposed to be its active organic antiseptics, for the carbolic acid of Dobell's solution. Seiler's wash and tablets are attempts of this nature. Unfortunately listerin, instead of being a sedative to mucous membranes, is an irritant, and hence Seiler's wash is devoid of the sedative effects of the older Dobell's solution. Diluted listerin is acid in reaction and somewhat irritating to mucous membranes, and hence better adapted as a spray or wash to atrophic than hyperthropic rhinitis.

4. ℞ Alphasol.
Sig. Dilute with 3 parts of water and use with an atomizer as a spray for the nose.

5. ℞ Glycothymolin.
Sig. Dilute with 3 parts of water and use with an atomizer as a spray for the nose.

6. ℞ Lythol.
Sig. Dilute with 5 parts of water and use with an atomizer as a spray for the nose and throat.

7. ℞ Thymozone.
Sig. Dilute with an equal amount of water and use with an atomizer as a spray for the nose and throat.

8. ℞ Alkalol.
Sig. Dilute with an equal amount of water and use with an atomizer as a spray for the nose and throat.

9. ℞ Borolyptol.
Sig. Dilute with 10 parts of water and use with an atomizer as a spray for the nose and throat.

10. ℞ Euzone.
Sig. Dilute with 4 parts of water and use as a spray for the nose.

The last eight formulas are a few of the numerous proprietary preparations manufactured for use as nose- and throat-washes. They are evidently elegant preparations as far as taste and smell are concerned, and under certain conditions it might be convenient to prescribe them.

11. ℞ Hydrogen dioxid.

Commercial peroxid of hydrogen is sold usually as a 3 per cent., equal to a 15-volume, solution of the gas. Its strength can readily be increased by evaporating the solution in a shallow vessel at a temperature considerably below the boiling-point, as under such circumstances the evaporation is much more rapid than the decomposition of the solution, and a strength of 100 volumes or even more is readily obtained. The stronger solutions are *caustics*, quickly destroying living tissue. The ordinary 15-volume solution is very irritating to the mucous membrane of the nose and pharynx and, therefore, it should not be prescribed indiscriminately in catarrhal affections as a spray or gargle.

Its chief use in rhinology and otology is for the removal of pseudomembranes, the cleansing of pus-cavities, and as a hemostatic, but when used for any of these purposes its irritating qualities should be borne in mind.

When brought into contact with organic substances peroxid of hydrogen is decomposed with the liberation of nascent oxygen, which unites with the organic substance, often greatly increasing its bulk. When applied to a pseudomembrane in the pharynx the membrane is not only softened and decomposed, but its increase in bulk greatly facilitates its removal. For the removal of pseudomembranes the peroxid is best applied by means of a swab, made by wrapping cotton about the end of an applicator. In this manner the peroxid may be not only rubbed into the pseudomembrane, but the rubbing assists in detaching it from the mucous membrane. Of course the "rubbing" should be

done with judgment and gentleness, and it is rarely necessary to use a solution stronger than 3 per cent. The action of the swab may be assisted, if necessary, by spraying the membrane, if desirable, by means of an atomizer.

For *cleansing* the middle ear, the antra of Highmore, or other cavities of pus, 3 per cent. peroxid, diluted with 1 or 2 parts of water, is generally sufficiently strong. Care should be used in injecting peroxid into a cavity that there is an opening sufficiently large to permit the easy escape of the gases generated by the decomposition of the peroxid. Should this not be the case, the pressure generated may be sufficient to cause great pain and, in the case of the middle ear, syncope and vertigo. In fact it is injudicious to inject peroxid through a small opening in the drum-head or a narrow sinus leading upward into the attic and mastoid antrum. It is stated that in the attic peroxid is capable of doing more harm than good by carrying pus into localities previously unaffected during its ebullition and thus spreading the infection. In the antra of Highmore peroxid is very valuable in loosening and disintegrating masses of adherent mucopus, and it is judicious to use at least one syringeful of diluted peroxid when cleansing that cavity.

As a *hemostatic* peroxid acts by causing an immediate clotting of the blood with which it is brought into contact, and the clot formed under such circumstances is very bulky and firm. When pledgets of cotton soaked in peroxid are inserted into a bleeding nostril the blood coming into contact with the peroxid is immediately clotted, and until the peroxid is exhausted the more bleeding the more clotting, and consequently the more pressure upon the bleeding vessel. Remedies like adrenalin, that cause contraction of the blood-vessels, are generally of little use for controlling nasal hemorrhage, because the flow of blood prevents them from coming into contact with the nasal mucous membrane and producing any effects.

12. ℞ Caroid.

Caroid is a bland, unirritating, powdered extract of the *Carica papaya* plant. It readily digests or dissolves small sequestra, cheesy pus, cholesteatomatous scales, and pseudomembranes, etc. It may be used as a dusting-powder within the tympanum or as a solvent in necrosis.

13. ℞ Enzymol.

Enzymol is a purified solution of pepsin prepared for external use. It is bland and unirritating and can be used freely within

the ear. It is especially useful in bringing about a cure of sinuses in the mastoid bone. For this purpose the sinus is first cleansed by syringing with sublimate solution, after which enzymol is injected and allowed to remain. The injections are made at intervals of twenty-four hours, and sometimes only three or four such injections are required to bring about the closure of a sinus that may have been discharging for months. Enzymol may also be injected by means of Blake's cannula into the vault of the tympanum in the expectation of digesting and dissolving any cholesteatomatous masses or necrosed bone that may exist there, or the solution may be used at home by the patient. He should, after getting into bed, lie on his side, with the diseased ear uppermost, and fill its canal with enzymol. The fluid should remain in the ear as long as possible, as prolonged contact with morbid material is required in order to secure its digestion or solution. Neither enzymol nor caroid has any effect upon living tissues. In this respect they are, of course, similar in action to gastric juice.

PROTECTIVES

14. ℞ Fluid albolene.

Many of the bleached or white fluid cosmolins or vaselins for sale in the market are bland and unirritating, while others are very irritating to sensitive mucous membranes. The surgeon should assure himself of the bland and unirritating qualities of such preparations before using them in his office practice or prescribing them for the use of his patients. Certain gums and camphors nearly insoluble in water may be dissolved in fluid vaselin or albolene and used with advantage as applications to mucous membranes. Probably the most useful of such substances are menthol and camphor.

15. ℞ Fluid albolene, ℥j;
Camphor, gr. x.—M.
Sig. Use with an atomizer.

The above solution of camphor in albolene is sedative and slightly astringent.

16. ℞ Fluid albolene, ℥j;
Menthol, gr. x.—M.
Sig. Use with an atomizer.

A solution of menthol in oil of the above strength, when applied to the nasal mucous membrane, produces at first a sensation of irritation, followed by decided sedative effects and a sen-

sation of cold. Its analgesic properties in acute coryza are decided. Frontal headache as a result of a cold in the head is promptly relieved by spraying the nasal mucous membrane with the above formula.

A useful formula as a protective to the nasal mucous membrane and for injection through a catheter into the middle ear is the following:

17. ℞ Menthol, gr. v;
Camphor, gr. xx;
Albolene, ℥ij.—M.
Sig. Use with an atomizer.

To the above 1 or 2 drops of oil of eucalyptus, oil of pine, or oil of cinnamon may be added.

Benzoinol is a proprietary preparation, said to be a solution of gum benzoin in albolene.

LOCAL ANESTHETICS AND ANALGESICS

18. ℞ Solution of the hydrochlorate of cocain, 4 per cent.

19. ℞ Solution of the hydrochlorate of cocain, 10 per cent.

The local anesthesia produced by the application of a 4 per cent. solution of cocain to the nasal mucous membrane, although later in making its appearance, is more profound and enduring than if a stronger solution were employed. This is probably due to the fact that contraction of the superficial blood-vessels occurring almost immediately after the application of a strong solution of cocain interferes greatly with its further and deeper absorption. For the removal of a large septal spur or the correction of a deviated septum a 4 per cent. solution of cocain should remain in contact with the parts for half an hour just previous to operating. The line of the saw-cut may be painted lightly with a 10 per cent. or stronger solution of cocain and the naris sprayed with adrenalin solution (1 : 1000). The solution of cocain should not be used with an atomizer for the purpose of producing anesthesia of the nasal mucous membrane, as it is liable to find its way into the pharynx and produce a most disagreeable sensation, the throat "feeling as if it were full of cotton," or some of the solution might even be swallowed and produce an untoward constitutional effect. When it is desired to produce local anesthesia of any portion of the interior of the nose for the purpose of a short operation, like the removal of a small septal spur or a cauterization, the removal of polypi, etc., a piece of

absorbent cotton should be saturated with the cocain solution and laid in contact with that part of the nose where the anesthesia is desired, and, after the lapse of a few moments, the sensibility of the parts tested with a probe, and, if anesthesia has not been produced, the piece of absorbent cotton should be again dipped in the solution of cocain and replaced within the nose. Practically a bloodless operation can usually be secured by then spraying the parts with a solution of adrenalin hydrochlorid (1 : 1000).

Various formulas containing cocain have been advocated from time to time as being more reliable for local anesthesia than a simple solution of cocain. However, none of them are extensively used by the profession. Both *chloral* and *carbolic acid* have some value as local anesthetics to mucous membranes, and the following formula has the advantage over a solution of cocain that it does not as rapidly deteriorate, because both carbolic acid and chloral are antiseptics. Its anesthetic effects in the nose are about equivalent to a 3 per cent. solution of cocain and appear very rapidly:

20. ℞ Cocain, gr. xiij;
Chloral hydratis, gr. viij;
Acidi carbolici, gr. vj;
Aquæ destil., ʒj.—M.
Sig. For use in the nose as a local anesthetic.

Anesthesia of the larynx should be produced by throwing a fine spray of a 10 per cent. cocain solution upon the laryngeal mucous membrane, and repeating the procedure after an interval of two or three minutes. The sensibility of the larynx should then be tested with a cotton-tipped applicator dipped in a 10 per cent. solution of cocain from time to time, until the applicator can be moved about freely in the larynx without producing a reflex spasm, as there is little use in beginning an operation on the larynx when every touch of an instrument is followed by spasm or retching and gagging. Anesthesia of the larynx, produced by the application of a solution of cocain, appears quickly after the application and lasts only a short time. Apparently cocain can be used more freely in the larynx than in either the nose or ear without danger of poisonous effects.

Watery solutions are not absorbed with sufficient facility by the skin to render their use inside the auditory canal at all satisfactory for producing local anesthesia. Diminished sensibility of the drum-head and of the walls of the canal may, however, be secured by rubbing well into the skin a 10 per

cent. ointment of *cocain in lanolin*, and this ointment is probably better than preparations of morphin, atropin, etc., for the relief of the pain of otalgia. When prescribed for this purpose it should not, of course, be rubbed into the skin of the canal, but simply inserted within the meatus, due care being exercised when the drum-head is absent not to use a sufficient quantity to produce a poisonous effect. When the drum-head is present the ointment will remain for days in contact with it and be slowly absorbed. Its sedative effects are, under such circumstances, followed by no reaction.

For the production of local anesthesia for the *removal of aural polypi* a pledget of cotton saturated with a 4 per cent. solution may be allowed to remain for five minutes in contact with the parts. This method, however, is not adequate for the production of local anesthesia in removal of the ossicles or, in fact, any of the more painful and tedious intratympanic operations, which ordinarily necessitate the almost complete local anesthesia resulting from the subcutaneous injection of equal amounts of a 1 per cent. solution of cocain and a 1 : 1000 solution of adrenalin in several places beneath the skin of the canal at the junction of the bony and cartilaginous portions. An ordinary hypodermic syringe with a small needle about 2 inches long, reinforced to within $\frac{1}{2}$ inch of its point, is convenient for the injections; 10 or even 20 minims may be required to produce complete anesthesia of the middle ear. According to Ballin, who first described this method, the fluid should be injected beneath the skin at the upper portion of the canal at the junction of the cartilaginous and bony parts. Within a few moments after the injection anesthesia of the middle ear is so complete that the removal of the malleus and incus and the remains of the membrana tympani can be accomplished often bloodlessly and with scarcely more pain than would result from intratympanic syringing.

Eucain, alypin, stovain, and several other substances have been offered as substitutes for cocain, the claim being that they possess anesthetic qualities similar to those of cocain and are less liable to produce toxic effects.

In cases that are known to be sensitive to the toxic effects of cocain it would be well to employ one of these substances. Alypin may be employed successfully in a 10 per cent. solution in the same manner as a 4 per cent. solution of cocain. It does not, like cocain, produce a contraction of the blood-vessels of the nasal mucous membrane. According to Dr. Tapia, of Madrid, stovain, which should be used in the same strength as cocain, is far less toxic and because of its diuretic properties is quickly

eliminated from the system. The fact that neither alypin nor stovain contract the tissues renders them valuable anesthetics in operations upon posterior nasal hypertrophies.

Two varieties of eucain are dispensed—alpha and beta. The latter is claimed to be three and three-fourths times less toxic than the former. Beta-eucain is employed as an anesthetic in about the same strength of solution as cocain.

HEMOSTATICS

21. ℞ Adrenalin hydrochloratis, 1 : 1000.

The active blood-pressure-raising principle obtained from the suprarenal capsule of beeves or sheep is variously designated by manufacturers, probably for commercial reasons. For example, *suprarenalin* and *adnephrin* are apparently the same as adrenalin. The substance is usually sold in 1 : 1000 solution, containing ½ of 1 per cent. of methaform or some other antiseptic to prevent the decomposition of the adrenalin, which somewhat rapidly occurs when the solution is diluted. For this reason adrenalin is prepared by some manufacturers in tablets, one of which dissolved in 15 minims of water yields a 1 : 1000 solution. The solutions prepared by dissolving one of the tablets contains no antiseptic to irritate the nose, and for this reason is somewhat better in the treatment of hay-fever and other conditions where the nasal mucous membrane is irritable. In the same class of cases adrenalin dissolved in albolene or an ointment of adrenalin yields better results than a watery solution.

Locally adrenalin solution may be used as a spray or applied by means of absorbent cotton. For the relief of local congestions a 1 : 5000 or even 1 : 20,000 solution yields good results. To produce local ischemia in mucous membranes preparatory to a surgical operation a 1 : 1000 solution is generally employed.

The best results are obtained by applying pledgets of cotton saturated with a 4 per cent. solution of cocain to the field of operation within the nose and after half an hour spraying the parts with adrenalin solution (1 : 1000). If after a moment or so the parts are not sufficiently blanched, more of the spray should be used.

When used in this manner small exostoses can often be sawed from the nasal septum without the loss of a drop of blood unless a vessel of considerable size be encountered. However, *secondary hemorrhage* occurring one or two hours after a nasal operation is said to be more common when adrenalin has been em-

ployed, because the ischemia of mucous membranes produced by adrenalin applications is apparently followed by congestion when the effects of the drug have passed off.

The fact that applications of adrenalin to the nasal mucous membrane are followed by congestion as soon as the effects of the drug have passed prevents the remedy being entirely satisfactory in the treatment of hay-fever. The best results are obtained by somewhat frequent applications, say once in two or three hours, of a solution not stronger than 1 : 5000 or 10,000 or one of the oily preparations of adrenalin. However, in spite of every precaution, after a few days the condition of a hay-fever patient using local applications of adrenalin is in nowise improved, and is usually worse, because the remedy is in no sense curative. At best it gives only temporary relief.

The *powdered* suprarenal gland is sometimes given internally in doses of 2 to 5 gr. three or four times a day in the treatment of hay-fever, or 5 to 30 minims of a 1 : 1000 solution of adrenalin may be given as often as every two hours in hemoptysis and hemophilia.

When given internally the effect of adrenalin upon the heart should be borne in mind and watched with a certain amount of caution, although no more serious results than headaches and dizziness are likely to occur from its prolonged use in considerable doses.

The effects of adrenalin on the *heart* are similar to those of digitalis, with the difference that it acts with greater rapidity, its effects are not as prolonged, and the blood-pressure-raising effect is more apparent. It slows the pulse and strengthens the cardiac systole while it shortens and renders diastole less perfect. It is a valuable cardiac stimulant and may be used hypodermically in heart failure during chloroform anesthesia.

Adrenalin is usually classed among the alkaloids, because it is a nitrogenous compound forming salts with acids. It probably exists in the suprarenal capsules in combination with some organic acid. It is decomposed by prolonged contact with alkalies and, therefore, should not be prescribed in conjunction with an alkaline nose-wash. It is a reducing agent and, therefore, should not be used in conjunction with hydrogen dioxid, permanganate, etc. It attacks many metals, tarnishing them and producing a black precipitate, therefore adrenalin solutions should not be allowed to remain for any great length of time in atomizers with metal tubes.

In nasal hemorrhage Mulford injects 10 drops of a 1 : 2000 solution of adrenalin into the middle of the upper lip of the

same side as the bleeding nostril. He reports 3 very severe cases of epistaxis promptly controlled by this method.

22. ℞ Acidi tannici,
Acidi gallici, āā gr. xx.—M.
Sig. Add to a tumblerful of water and slowly sip the mixture.

Useful in controlling oozing of blood from the wound after amputation of the tonsil.

HEMOPTYSIS, EPISTAXIS

23. ℞ Ergotin. (aq. ext.), ℥j;
Ext. hyoscy. alc., gr. iij.—M.
Ft. cap. No. xx.
Sig. 1 every three hours.

24. ℞ Acidi gallici, ℥iss–iij;
Spts. rectif., ℥ss;
Glycerini, ℥iiiss.—M.
Sig. 1 teaspooonful every two hours.

25. ℞ Plumbi acet., gr. xxiv;
Pulv. opii, gr. xij.—M.
Ft. chart. No. xii.
Sig. 1 every four hours.

26. ℞ Ol. terebinth., ℥j;
Muc. acaciæ, ℥iij;
Ol. gaultheriæ, ♏ij.—M.
Sig. 1 teaspoonful every hour with water.

27. ℞ Liq. ferri persulph.,
Glycerini, āā ℥ss.—M.
Sig. 10 drops every hour if necessary.

28. ℞ Calcii chloridi, gr. xl.—M.
Ft. cap. No. viii.
Sig. 1 every hour until the bleeding is controlled.

The investigations of A. E. Wright seem to prove that the effect of calcium chlorid is to increase the coagulability of the blood, but if too large a quantity of the drug is given the opposite result is caused, namely, diminished coagulability. On this theory 2 or even 3 capsules (10 to 15 gr.) may be given at intervals of an hour in severe cases, but the amount of 80 gr. should not be exceeded in as many hours. Even in cases where the hemorrhage has not been completely controlled, if 80 gr. have been given within eighty hours, it is best to wait several hours before again resorting to the drug.

LOCAL SEDATIVES

29. ℞ Antipyrin, gr. x–xxx ;
Aquæ, f℥j.—M.

A solution of antipyrin of 2 to 4 per cent. strength, when sprayed upon the mucous membrane of the nose or pharynx, has the power of contracting the capillaries and of producing an artificial anemia, which effect is maintained for from three to five hours. Solutions of antipyrin may be used with the atomizer in all acute inflammations of the mucous membrane of the upper respiratory tract. When used after the application of cocain to the interior of the nose a 4 per cent. solution will maintain the contractile effect of cocain upon the erectile tissue for several hours. When sprayed upon the nasal mucous membrane without the previous application of cocain a 4 per cent. solution gives rise to a smarting sensation, which, however, quickly subsides. Antipyrin solutions of the proper concentration applied to mucous membranes produce analgesia, but not local anesthesia.

30. ℞ Antipyrin, ℥i–iij ;
Aquæ, q. s. f℥ij.—M.

This formula is extremely useful as a daily application to the larynx in all forms of laryngeal inflammation. A brush or a dossil of absorbent cotton wrapped about a bent probe should be saturated with the solution and applied to the glottis. The application of antipyrin solutions of the strength of 50 per cent. and upward produces a burning sensation, quickly followed by a sensation of relief and comfort. Applied in this manner to the larynx antipyrin is not an anesthetic, but an analgesic whose effects persist for several hours. In the strength of 5 to 10 per cent. solutions antipyrin is superior as an antiseptic to Van Swieten's liquid. In therapeutic doses antipyrin acts as an antispasmodic, diminishing the reflex excitomotor power of the spinal cord, and also as an analgesic, relieving the pain of neuralgia and migraine, whether due to reflex nasal irritation or to some other cause. Applications of strong solutions of antipyrin to the larynx should be supplemented by the patient inhaling five or six times a day the spray from an atomizer containing a 4 per cent. solution. The effects of antipyrin upon the heart should, of course, be borne in mind and the patient, if weak, should be cautioned not to swallow any portion of the spray deposited in the mouth, and not to use too large a quantity of the solution at one time, although in a 4 per cent. solution there is in 1 ounce only about 20 gr. of antipyrin, and much more than this amount

in twenty-four hours probably could be used with impunity by most patients.

31. ℞ Atropiæ sulphatis, gr. iv;
Morphiæ sulphatis, ʒj;
Aquæ, fʒj.—M.

One or two drops may be applied inside the auditory canal for relief of the pain incident to acute inflammation of the middle ear and myringitis.

32. ℞ Iodoformi, gr. lx;
Ether, ʒij.—M.
Sig. Use as a spray for the larynx.

PIGMENTS

33. ℞ Iodini, gr. v;
Potassii iodidi, gr. xv;
Glycerini, fʒj.—M.

34. Boroglycerid, 50 per cent.

35. ℞ Acidi tannici, gr. xl;
Glycerini, fʒj.—M.

Formula 35 is an excellent application to the nasopharynx in the postnasal catarrh of adults. In children, Formula 33 generally yields better results.

Formulas 33–35 may be used in the treatment of chronic and hypertrophic rhinitis. The effects of the applications vary with the amount of the solution used. No more of the iodin solution should be applied at one time than will produce a momentary sensation of discomfort. Applied inside the crypts of the tonsils by means of a cotton-tipped probe bent at a right angle it often brings about a rapid absorption of the hypertrophied glands. Either of the solutions may be applied by means of a suitable cotton-tipped probe to the mucous membrane of the nose or nasopharynx.

36. ℞ Lignol,
Oleum olivæ, *āā* fʒj.—M.

Lignol is an oily or tarry substance resulting from the distillation of a special lignite. It is soluble in ether and oils, but not in water. It contains phenol, guaiacol, xylenol, etc., probably combined with pyridin bases. It has antiseptic properties equivalent to a 1 : 1000 bichlorid solution, and when properly diluted is not irritating to mucous membranes. It is a useful

application in atrophic rhinitis, diluted with an equal amount of sweet oil or albolene.

37. ℞ Petroleum, gm. 40.00;
Olei eucalypti odoris citri, gm. 0.50;
Strychniæ nitratis, gm. 0.02.—M.
T. Bobone.

Useful as a pigment in atrophic rhinitis.

OINTMENTS

38. ℞ Ichthyol, ℥ij;
Adeps lanæ,
Petrolati, *āā* ℥j.—M.

Useful as an inunction over the mastoid in commencing mastoiditis, and as an inunction over hypertrophied lymphatic glands in the neck.

39. ℞ Unguenti hydrargyri,
Unguenti iodini, *āā* ℥j.—M.

Useful as an inunction over the mastoid in commencing mastoiditis, and as an inunction over hypertrophic lymphtic glands about the angle of the jaw.

40. ℞ Unguenti hydrargyri,
Unguenti iodini,
Unguenti belladonnæ, *āā* ℥j.—M.

Useful as an inunction within the auditory canal in furunculous and diffuse inflammation.

41. ℞ Hydrargyri oxidi flavi, gr. vj;
Olei petrolati, q. s.
Petrolati, ℥j.—M.

Useful as an application in eczema of the auricle after all scabs and crusts have been removed by means of peroxid of hydrogen. This ointment should be well rubbed into the inflamed tissues, and a single application is sometimes sufficient to bring about a cure if care be exercised that purulent discharges from the tympanum are not allowed to come into contact with the skin of the auricle.

42. ℞ Plumbi iodidi, gr. xlv;
Ammon. chloridi, gr. xlv;
Ichthyol, ℥j;
Adeps lanæ, q. s. ad. ℥j.—M.
Ft. unguentum.
Sig. External use in glandular inflammations.

43. ℞ Cocain hydrochloridi, gr. xij;
Adeps lanæ, ℥ij.—M.

Useful in relieving the pain of subacute catarrh of the middle ear, furunculosis, etc. An ointment penetrates the skin of the canal more readily than a watery solution. For the relief of the pain of aural neuralgia or acute catarrh the ointment is simply placed as deeply within the canal as possible. For the relief of the pain of furunculosis the ointment is smeared upon a cone of cotton, which is wedged into the meatus with as much pressure as the patient conveniently can bear. The pressure, at first painful, ultimately relieves congestion and discomfort.

CAUSTICS

With the exception of the galvanocautery the caustics most employed in rhinology and otology are chromic and trichloracetic acids. As the destruction of tissue produced by applications of even the solid stick of nitrate of silver is very superficial, it scarcely can be considered a caustic.

ASTRINGENTS

44. ℞ Zinci sulphatis, gr. x–xx;
Aquæ, f℥j.—M.

Useful as an application by means of a brush or a dossil of absorbent cotton to the pharynx and larynx in subacute and chronic laryngitis, and to the nasopharynx in subacute nasopharyngeal catarrh.

45. ℞ Tinctura ferri chloridi,
Glycerini, *āā* f℥ss.—M.

Useful as an application to erosions over varicose vessels in chronic nosebleed.

46. ℞ Acidi gallici, gr. v–x;
Petrolati, ℥j.—M.

Sig. For patient's use in recurrent nasal hemorrhage and in the chronic rhinitis of children. A piece the size of a pea should be inserted in each nostril night and morning.

47. ℞ Pil. atropiæ sulphatis, gr. $\frac{1}{200}$.
Sig. 1 every three or four hours.

Useful in controlling excessive nasal secretion in coryza, hay-fever, and nasal hydrorrhea.

48. ℞ Atropiæ sulphatis, gr. ss–iss ;
Aquæ destil., f℥ij.—M.
Sig. Use with an atomizer every two hours.

Useful in nasal hydrorrhea. The patient should be informed that the solution is highly poisonous, and cautioned against using a larger quantity than sufficient to barely moisten the nasal mucous membrane each time the atomizer is used.

49. ℞ Alcohol, 95 per cent.

Useful as an application to the tympanic mucous membrane when it is covered by granulations and small polypi. For the patient's use at home, to cause shrinking of granulations and polypi, alcohol, diluted with an equal amount of water, may be prescribed, to be dropped into the auditory canal several times a day. Should this cause only momentary smarting, the patient should on the next occasion use alcohol 2 parts diluted with water 1 part, and so on until undiluted 95 per cent. alcohol is dropped into the ear four or five times a day. Practically the ear will then contain alcohol all the time. It acts as a dehydrating agent on polypi and exuberant granulations, destroying their vitality and promoting cicatrization. Its value as an antiseptic also plays its part in bringing about a good result. Boric acid dissolved in the alcohol is sometimes prescribed for the patient's use, but, as under such circumstances when the alcohol evaporates the boric acid is deposited as sharp-pointed crystals on the mucous membrane, it is probable that the boric acid is a source of irritation. The same may be said to a less degree of the addition to the alcohol of other dehydrating agents like glycerin and sulphuric ether. In order to secure the best results from instillations of alcohol the patient should lie down with the affected ear uppermost and then straighten the canal upward, outward, and backward. The canal should then be *filled* with alcohol, which should be forced into the tympanum by manipulating the tragus. This procedure also serves to float outward particles of pus and other materials. Polypi of considerable size may be destroyed by this method, but it is somewhat tedious if the polypi are large, and hence such growths should be removed by snare or forceps.

50. ℞ Argenti nitratis, gr. x–℥ij ;
Aquæ, f℥j.—M.

Silver nitrate (℥j to 1 ounce of water) is useful as an application to the pharynx or tonsils in acute pharyngitis or tonsillitis. When applied sufficiently early it will often abort the disease if

used two or three times a day. When painted upon the lateral walls of the pharynx it produces at once a feeling of relief and comfort which persists for some time; when painted upon the posterior wall of the pharynx, a sensation of dryness and great discomfort. Hence it should not be used in this portion of the pharynx except for touching small areas of granulation tissue, etc. However, 10-gr. solutions are permissible.

Solutions of silver nitrate (60 gr.) also may be used as an astringent application to small polypi and exuberant granulation tissue in the tympanum. However, for this purpose it is far inferior to strong alcohol. Even the solid stick of silver nitrate when applied to granulations in the ear produces only a superficial destruction of tissue, and in this respect is far inferior to chromic or trichloracetic acids.

51. ℞ Protargol.

52. ℞ Argyrol.

The above are two of the best of the organic compounds of silver. Of the two, argyrol is probably the more valuable in controlling inflammations of mucous membranes. Protargol may be used as a spray to the pharynx or larynx in 10 per cent. solutions and argyrol in 20 per cent. solutions. Both produce ugly stains on linen, but do not stain the skin. They stop up atomizer tubes somewhat quickly, and hence are not well adapted for patient's use at home. Protargol and argyrol, when applied to mucous membranes, are somewhat astringent antiseptics, are devoid of the irritating effects of silver nitrate, and penetrate the tissues more deeply. Argyrol in 10 per cent. solution is especially serviceable in the recurrent attacks of otorrhea where the drumhead has been destroyed. If applied at an early stage of the attack a single application by means of a cotton-tipped probe will usually abort the attack. It is valuable as a non-irritating antiseptic injection by means of Blake's cannula into the attic of the tympanum in attic otorrhea, often bringing about a cessation of the discharge.

Purulent inflammation of the accessory sinuses of the nose may be treated by first cleansing them by injections of sterile water, peroxid of hydrogen, etc., and then injecting a small quantity of a 20 per cent. solution of argyrol, which is allowed to remain. The non-toxic and non-irritating properties of this antiseptic permits this being done with impunity. Under such circumstances the discharges are stained brown and are rapidly changed in character from purulent to mucoid.

DUSTING-POWDERS

53. ℞ Menthol, gr. j;
Sodii bicarb., gr. ij;
Magnesii carb. (levis), gr. iij;
Cocain hydrochlor., gr. iv;
Sacchari lactis, ℥iss.—M.
Sig. Use as snuff every two or three hours.

The most marked relief follows the use of this powder, and a few applications will do much to abort acute rhinitis. Its effects are immediate, highly agreeable to the patient, and continue for a number of hours. The preparation should be dispensed in a tightly-corked vial to prevent evaporation of the menthol, and a pinch should be sniffed up into each nostril every two or three hours or sufficiently often to maintain the nose in a putulous condition and limit the secretions. As the result of the use of the snuff the patient remains practically free from all nasal symptoms during the attack, and there is no danger of contracting the cocain-habit where the laws, as in Pennsylvania, forbid the refilling of a prescription containing cocain without the consent of the physician.

54. ℞ Argenti nitratis, gr. x;
Zinci stearatis, ℥j.—M.

55. ℞ Argenti nitratis, gr. xx;
Zinci stearatis, ℥ij.—M.

Formulas 54 and 55 are useful in the treatment of atrophic rhinitis. Formula 54 should be applied with the powder-blower to the nasal mucous membrane as long as its use is followed by a moderate amount of smarting and increased nasal discharge. When this ceases to occur Formula 55 may be used.

56. ℞ Zinci sulphatis,
Sacchari lactis, *āā* ℥ij;
Acaciæ, gr. x.—M.

57. ℞ Alumnol, ℥j;
Sacchari lactis, ℥ij.—M.

Useful as applications to the laryngeal mucous membrane in acute and chronic laryngitis. In cases in which bronchitis as well as laryngitis is present the powder should be applied during deep inspiration, in order that it may reach the trachea and bronchi.

58. ℞ Iodoformis, gr. xxx ;
Acidi tannici, gr. xx ;
Sacchari lactis, gr. xxx.—M.

Useful as an application in syphilitic and tuberculous laryngitis.

59. ℞ Bismuth. subnitratis, ʒij ;
Acaciæ, gr. x ;
Iodoformis, ʒss ;
Morphiæ sulphatis, gr. xx ;
Acidi tannici, gr. xxx.—M.

Useful as an application to the laryngeal mucous membrane in tuberculous and syphilitic laryngitis, in the earlier stages of acute laryngitis, or in any laryngeal affection characterized by irritability and pain.

60. ℞ Orthoform.

This nearly insoluble substance has the property of producing analgesia when applied to exposed nerve-endings. It is, therefore, especially valuable as an application to irritable ulcers after they have been cleansed with Dobell's solution or peroxid of hydrogen. Its anesthesic effects are increased by a previous application of a solution of cocain and persist for four or five hours. When insufflated into a tuberculous larynx the powder produces a momentary smarting, followed by analgesia more or less complete, which persists as long as the powder adheres to an abraded surface or an ulcer. The powder possesses decided antiseptic qualities and promotes the healing of tuberculous ulcerations. It has little effect upon the unbroken mucous membrane and its prolonged application to the skin in the neighborhood of ulcerations sometimes causes eczema.

A nurse or one of the patient's friends can be taught to insufflate orthoform into a tuberculous larynx ten minutes before each meal, and in many instances thus secure complete relief from dysphagia. Orthoform is said to be non-toxic, and hence may be used locally in liberal quantities.

61. ℞ Pulvis acidi borici.

It is absolutely necessary that the powdered boric acid, insufflated within the tympanum as an application in the treatment of purulent inflammation, should be impalpable and free from all grit, as the sharp-pointed crystals of this substance are extremely irritating. A good plan is to test the powdered boric acid by rubbing a small quantity upon the lip with the tip of a finger,

rejecting as unfit for use inside the ear those specimens that are "gritty."

It is important also that too large a quantity of boric acid should not be thrown into the ear at one time or it may form a hard mass and thus prevent the escape of discharges. This is less likely to occur if the powdered boric acid be triturated with tincture of calendula officinalis, as advised by Sexton.

The following powders are of use in the treatment of otorrhea:

62. ℞ Chinolini salicylatis, ʒss–j;
Pulvis acidi borici, ʒj.—M.
Burnett.

63. ℞ Aluminii, gr. x;
Pulvis acidi borici, ʒj.—M.

64. ℞ Iodoformi, ʒj;
Pulvis acidi borici, ʒj.—M.

65. ℞ Pyoktanin, ʒj;
Acidi borici, ʒi–ʒj.—M.

Sig. Use as a dusting-powder in otorrhea where the opening through the drum-head is sufficiently large to permit the entrance of the powder into the tympanum.

Pyoktanin (*pus destroyer*) or methyl-violet is an anilin dye occurring in the form of a paste and in crystals. It is said to penetrate the tissues and act upon deeply imbedded pathogenic micro-organisms. It has been used somewhat more extensively than at present in the treatment of otorrhea. The chief objection to its use is the deep-blue stain imparted to the skin of the auricle by discharges containing pyoktanin when they escape from the canal. This stain, however, is somewhat readily removed by washing with alcohol.

Solutions of pyoktanin of the strength of 1 : 1000 or even 1 : 100 may be injected into the attic in chronic otorrhea after a preliminary cleansing with water and peroxid of hydrogen. Under such circumstances it penetrates somewhat deeply and is rapidly absorbed by any bacteria present. These are deeply stained and are said to be killed or at least rendered inert by the dye. Pyoktanin may also be used as a dusting-powder combined with boric acid, as in the above formula.

The paste is sometimes molded into the form of pencils and used to rub into syphilitic ulcerations, etc. A variety of the drug is yellow, but is said not to be so active as the violet pyoktanin.

Pyoktanin, when given internally in doses of 2 or 3 gr. three times a day, stains the urine a deep blue, and after the drug has been taken for two or three days the urine of such persons will remain aseptic for three weeks, even when exposed to the air in an open vessel. While pyoktanin undoubtedly possesses considerable value as a comparatively safe antiseptic, its usefulness has been greatly restricted, both in the treatment of otorrhea and in genito-urinary surgery, because of the objectionable blue stains which it produces.

66. ℞ Acetanilid, ʒj;
Acidi borici, ʒj.—M.
Sig. Use as a dusting-powder to infected or foul-smelling wounds after mastoid operations.

Acetanilid, a derivative of anilin, is a white powder but slightly soluble in water and possessing decided antiseptic properties. It is, either alone or diluted with boric acid powder, a somewhat popular hospital dressing for superficial wounds "that are not doing well." It is especially useful in wounds after a mastoid operation where the discharges are foul smelling and the chiseled bone remains long uncovered by granulations. The powder, under such circumstances, should be thickly dusted into the wound. Iodin is liberated when the substance is brought into contact with organic matter and acts as an antiseptic.

67. ℞ Nosophen.
Sig. Use as a dusting-powder for the nose or middle ear.

This compound, obtained by the action of iodin upon a solution of phenolphthalein, is free from odor or taste and contains 60 per cent. of iodin. It is free from irritating effects when applied to the mucous membrane of the nose or tympanum and may be used as a dusting-powder as a substitute for iodoform after operations in such localities.

68. ℞ Aristol (dithymol diiodid).
Sig. Use as a dusting-powder for the nose or middle ear.

Aristol is probably the most valuable of all the "substitutes for iodoform," as it has a faint but agreeable smell somewhat resembling thymol. It is used somewhat extensively as a dusting-powder to the wound after operations on the middle ear, nose, and pharynx to promote cicatrization. It is not irritating to the nasal mucous membrane. Aristol is a reddish-brown, amorphous powder, containing about 45 per cent. of iodin, which is slowly liberated into a wound dusted with this powder and packed with sterile gauze.

69. ℞ Iodomuth.

70. ℞ Bismuth. subiodidi.

Either of the above are sometimes useful as dusting-powders in otorrhea where a sufficient amount of the drum-head has been destroyed to permit their being thrown upon the exposed mucous membrane of the tympanum.

71. ℞ Pulveris alumini compositæ.

E. R. Squib & Sons.

The compound alum powder of Squib is often useful in promoting early epidermization of the tympanum after the radical mastoid operation.

72. Xeroform.
℞ Bismuth oxid, 49 per cent.
Tribromphenol, 50 per cent.

Xeroform or bismuth tribromphenol is an odorless synthetic product of the manufacturing chemists, and presumably has the sedative and astringent properties of bismuth combined with the marked antiseptic qualities of bromin and carbolic acid. As it has been given internally (5 to 7 gm. daily) by Hueppe, during the cholera epidemic at Hamburg, in 1893, with excellent results, it may be assumed that its local application to wounds and mucous membranes is absolutely devoid of danger of toxic effects. Upon wounded or inflamed mucous membranes it is an astringent, analgesic, and an antiseptic.

Somers (*New York Med. Jour.*, December 24, 1898) speaks with enthusiasm of the value of xeroform in aural practise. He has used it in more than 100 cases of chronic suppurative otitis media. It does not stain like pyoktanin or cake like boric acid, and it greatly modifies the character of the discharge from the middle ear. It promotes epithelial growth and cicatrization and relieves the annoying pruritus which tends to delay the repair of the tissues.

ALTERATIVES

73. ℞ Hydrargyri bichloridi, gr. j ;
Potassii iodidi, ʒij ;
Aquæ, fʒiij.—M.
Sig. 1 to 3 teaspoonfuls after meals.

This formula, sometimes called "1, 2, 3 mixture," may be ordered when it is desired to employ the mixed treatment in syphilis.

74. ℞ Tablet triturat. hydrarg. protiodidi, gr. ¼.
Sig. 1 tablet may be taken three or four times a day or even oftener, with a sufficient quantity of opium, if necessary, to prevent diarrhea.

Useful in the treatment of primary and secondary syphilis.

75. ℞ Pil. hydrarg. biniodidi, gr. $\frac{1}{16}$–$\frac{1}{8}$.
Sig. 1 pill may be taken after each meal.

Useful in the treatment of the later stages of syphilis.

76. ℞ Hydrarg. bichlor., gr. iij;
Aquæ destil., ℥j.—M.
Sig. Corrosive sublimate solution for hypodermic use.

♏x = gr. $\frac{1}{16}$. ♏xiij = gr. $\frac{1}{12}$. ♏xv = gr. $\frac{1}{10}$. ♏xx = $\frac{1}{8}$.

Useful in syphilitic affections of the nose and throat where it is advisable to get the patient under the influence of mercury as speedily as possible. The injections may be made as often as once a day, deep into the cellular tissue of the back. The injection causes a moderate amount of pain, which continues for about an hour, and the place where the injection was made remains a little sensitive to the touch for twenty to forty-eight hours; abscess does not occur when the proportion of corrosive sublimate is not greater than in this formula.

In a small proportion of cases mercury or iodid of potassium produce a violent reaction, the syphilitic lesions, for the time at least, being rendered worse instead of better by the exhibition of these drugs. Other cases, because of the disturbance of the gastro-intestinal tract, cannot tolerate either the iodids or mercury. Such cases generally do well on the following prescription:

77. ℞ Ext. berberis aquifolii, ƒ℥iv.
Sig. 15 to 120 drops in water every three hours.

The initial dose is 15 drops every three hours, increased 5 drops per week until the patient is taking 2 fluiddrams every three hours. The dose is then reduced each week until the initial dose of 15 drops is reached. This is continued for a week or two and again increased.

78. ℞ Tr. guaiac. ammoniati, ƒ℥j.
Sig. ½ teaspoonful in milk every three or four hours, gargle and swallow. See Formula 138.

Useful in acute pharyngitis or tonsillitis of rheumatic origin.

79. ℞ Potassii bromidi, ℥ss ;
Potassii iodidi, ℥iss ;
Ext. glycyrrhizæ, ℥iss ;
Aquæ, q. s. ad. f℥iv.—M.
Sig. 1 teaspoonful three or four times a day.

Useful in pharyngitis sicca, to increase the pharyngeal secretions and relieve the feeling of dryness in the throat.

HYPNOTICS

80. ℞ Trional, gr. x–xxx.

81. ℞ Sulphonal, gr. x–xxx.

82. ℞ Paraldehyd., f℥ss ;
Olei gaultheriæ, ♏x ;
Pulveris acaciæ, ℥ij ;
Elixir simplicis, q. s. ad. f℥iv.—M.
Sig. ½ to 1 tablespoonful in water every hour or two in the restlessness and insomnia following mastoid operations.

83. ℞ Chloral hydratis, gr. x ;
Codein sulphatis, gr. ½ ;
Strychniæ sulphatis, gr. $\frac{1}{40}$.—M.
Ft. chartæ No. i.
Sig. To relieve restlessness and insomnia after mastoid operations. Dissolve in half-tumblerful of water and repeat dose in three hours if necessary.

84. ℞ Somnos, f℥iij.
Sig. 2 teaspoonfuls to 1 tablespoonful every hour or two, if necessary, to quiet restlessness and induce sleep after operations.

After many severe operations on the nose, throat, or ear the patient for the first night or two will complain of pain, restlessness, and inability to sleep. This is especially true in neglected mastoid cases that have been operated on only after weeks of needless suffering and consequent demoralization and debility. In some such instances a hypodermic of ¼ gr. of morphin will be required in order to soothe the patient's sufferings. In other cases a reliable hypnotic produces the desired results. Under such circumstances the choice of an hypnotic in the patient's debilitated condition is by no means a matter of indifference, as all hypnotics are to a greater or less degree depressants. Sodium bromid (10 gr.) combined with chloral (5 gr.), repeated every hour if necessary, yielded good results in the practise of the writer for several years. More recently, however, he has relied either on Formula 83 or 84. It should be observed that in Formula 83 any possible depressant effect of chloral on the heart is guarded

against by the addition of a small proportion of strychnin. Both Formula 83 and the succeeding Formula 84 usually produce sleep after one or two doses are taken, and are apparently free from any depressant after-effects.

TONICS

85. ℞ Hydrarg. bichlor., gr. $\frac{1}{4}$;
Acidi arseniosi, gr. $\frac{1}{3}$;
Ferri pyrophos., gr. vj;
Quiniæ sulph., gr. xv.—M.
Ft. pil. No. xxiv.
Sig. 1 after meals.

Useful as a tonic pill in catarrh of the nose and throat, with a debilitated condition of the system.

86. ℞ Tincturæ gentianæ comp., ℥ij;
Elixir cinchonæ, ℥j;
Syrupi limonis, ℥ss;
Spiritis frumenti, q. s. ad. ℥viij.—M.
Sig. 1 or 2 tablespoonfuls in water before meals.

A useful formula where it is desired to administer an alcoholic stimulant, but where it is undesirable from any cause to advise the use of whisky pure and simple.

87. ℞ Ext. bellad. fol. alc., gr. iv;
Quin. sulph., gr. xxij;
Ferri sulph. exsic., gr. vij;
Strych. sulph., gr. $\frac{1}{4}$;
Acidi arsenosi, gr. $\frac{1}{5}$;
Oleoresinæ piperis, ♏viiss.—M.
Ft. pil. No. xv.
Sig. 1 pill three times a day.

Jour. of the Amer. Med. Assoc.

In the treatment of neuralgia of the ear, which is often a sign of defective nutrition and associated with anemia, the above combination is sometimes useful.

MISCELLANEOUS

88. ℞ Contractile collodion.

Contractile collodion is sometimes applied to a cicatrix or atrophic drum-head to hold it in a more favorable position for hearing. For this purpose, after inflation by Politzer's method, only a small amount of the collodion should be painted upon the drum-head at one time, as there is some danger of producing myringitis if too large an amount of the remedy is painted on the drum-head at one sitting.

89. ℞ Phosphorated oil.

Formerly many ointments and solutions were applied to the membrana tympani for the relief of tinnitus and deafness caused by catarrh of the middle ear. Although this form of medication has largely been abandoned, phosphorus dissolved in olive oil, if applied to the drum-head, will sometimes bring about improvement of the hearing in deafness due to senility.

90. ℞ Chloroformi.

91. ℞ Iodini.

92. ℞ Tincturæ iodini, ʒj ;
Æther, ʒj.—M.

93. ℞ Menthol.

The vapor of these substances is sometimes used as an application to the mucous membrane of the middle ear. They should be preserved ready for use in wide-mouthed, glass-stoppered bottles, so that the Politzer air-bag can be filled with their vapor by placing the nozzle of the bag within the neck of the bottle while the bag is expanding. Ether and chloroform vapor will sometimes penetrate into the middle ear through the Eustachian tube when it is impossible to inflate the middle ear with simple air by Politzer's method or the use of the catheter.

94. ℞ Tincture of gelsemium,
Tincture of lobelin, āā ʒj ;
Potassium bromid, ʒss.—M.
Sig. 20 drops in water every three hours.

Burnett.

The above is said to be almost a specific as regards relief in asthma.

95. ℞ Ac. carbol., gr. xxx ;
Ammon. carb., ʒj ;
Pul. carbo. lig., ʒj ;
Ol. lavend., ♏xx ;
Tr. benzoin co., ʒss ;
Gum camphor, ʒij.—M.
Sig.—Smelling salts for acute nasal catarrh.

96. ℞ Paraffin, ʒiv ;
Albolene, ʒv.—M.
Melt together in container surrounded by boiling water.
Sig. For use as a subcutaneous injection for the correction of nasal deformities, etc.

For *subcutaneous injections* sterile paraffin, with a melting-point of 112° F., is usually employed. When the melting-point is much higher than this, it is not readily forced through a long needle and does not as readily penetrate the spaces of the cellular tissue. When the melting-point is much lower than 112° F., paraffin behaves more like ordinary oil, permeates the tissues more readily, and may enter a vessel and cause embolus.

Ordinary commercial paraffin, whose melting-point is usually 128° F., may be reduced to a melting-point of 112° F. by adding 5 parts of albolene to 4 parts of paraffin, the mixture sterilized by boiling it and its container in water, and preserved for future use.

Thus prepared the melted paraffin should be drawn into a suitable syringe (Fig. 93), the nozzle of which is then closed with its screw cap. The syringe with the paraffin it contains and the necessary needle are then sterilized by boiling in water. The syringe and paraffin contained in it are then cooled in sterile water, the screw cap removed, the needle screwed in its place, and the instrument is then ready for use.

97. ℞ Acidi nitromuriatici
(concentrated, freshly prepared), f℥j.
Sig. 5 to 10 drops in a tumbler of water after meals and at bedtime.

In a large proportion of cases of *hay-fever* the above formula will eliminate all symptoms of the disease within forty-eight hours. If after two or three days' use of the remedy there is no improvement in the symptoms, it is probable that nitromuriatic acid will prove useless no matter how long continued.

Mineral acids in the treatment of hay-fever are said to owe their efficiency to the fact that they diminish the alkalinity of the blood to an extent that it is no longer capable of holding in solution uric acid, and hence the mucous membranes are no longer irritated by the secretion of this substance. However, in this connection it should be borne in mind that nitromuriatic acid has been employed for several generations as an alterative and tonic in gastro-intestinal diseases and in diseases of the liver, where it is said to increase the biliary secretions. It is probable, therefore, that when exhibited in the treatment of hay-fever that it not only frees the blood from uric acid but also, by improving metabolism, limits the formation of uric acid and perhaps other products of defective metabolism. It should be borne in mind also in this connection that mineral acids were formerly used more frequently than at present in the treatment of diseases of the upper respiratory tract, 10 drops of dilute nitric acid every two

hours in water being an old but usually effective remedy in the treatment of the *aphonia* of singers and orators.

The use of nitromuriatic acid may be commenced at any time before or during the hay-fever season. It is important that the acid be freshly prepared. At first a colorless liquid, it becomes within a few days yellow. The yellow color deepens almost to brown, but finally again becomes lighter, until at length the mixture is colorless. During this period of change in color fumes are given off and the remedy is then thought to be most active in its effects upon the gastro-intestinal tract. When 10 drops are diluted with a tumbler of water the water is only slightly sour to the taste, but it is well enough as a precaution against possible injury to the teeth to rinse out the mouth either with pure water or water to which a pinch or two of baking soda has been added.

If the use of nitromuriatic acid is successful in eliminating the symptoms of hay-fever, it is probable that they will cease to recur as long as the patient continues to take the remedy regularly. However, should he neglect to take a single dose, more especially the evening dose, it is probable that some symptoms of the disease will be quickly manifested. For example, if the evening dose be omitted, it is probable that the patient will wake up the next morning with his nose occluded and irritable and very likely will have several attacks of sneezing.

Prolonged use of nitromuriatic acid is apparently harmless. Some of the writer's earlier cases have used the acid for months at a time year after year during the hay-fever season, and occasionally some of them during the winter season as well, without noticing any deleterious effects. In cases where the remedy is effective, it is curative to the extent that it almost completely controls the symptoms during the hay-fever season, and there seems a tendency for the attacks to become less and less severe from year to year.

In neurotics suffering from hay-fever much benefit sometimes results from large doses (20 to 30 gr.) of bromid of sodium three times a day, which is ordinarily sufficient to control the violent attacks of sneezing. In such cases the following formula is often useful :

98. ℞ Acidi hydrobromici diluti, f℥ij.
Sig. 15 to 30 drops in a tumbler of water one hour after meals.

Hydrobromic acid also yields in the majority of cases somewhat better results in the treatment of tinnitus than bromid of sodium or the mixed bromids.

99. ℞ Ext. cimicifugæ racemosæ, f℥ij.
Sig. 15 to 20 drops after meals and at bedtime.

The above is sometimes useful in tinnitus. When effective its beneficial results are manifested within a few days. However, a rather large proportion of cases of tinnitus from chronic middle-ear catarrh are not benefited in the least by the use of cimicifuga.

100. ℞ Atropinæ sulphatis, gr. ¼;
Acidi sulphurici aromatici, f℥ij;
Aquæ rosæ, q. s. ad. f℥j.—M.
Sig. 20 to 30 drops at bedtime, repeated if necessary. Useful in the night-sweats of phthisis.

101. ℞ Acidi carbolici, gr. iij;
Pulveris camphoræ,
Resorcin, āā gr. xx;
Acidi borici, gr. xxx;
Unguenti zinci oxidi, ℥j.—M.
Fiat unguentum.
Sig. Use twice a day as an external application in acne rosacea of the nose.

102. ℞ Pilocarpinæ hydrochloras, gr. $\frac{1}{16}$–$\frac{1}{8}$.

Pilocarpin may be given hypodermically once a day in conjunction with potassium iodid three times a day by the mouth in effusion or hemorrhage into the labyrinth, tertiary syphilis, and traumatism involving the internal ear. The average dose of pilocarpin is about $\frac{1}{10}$ gr. hypodermically, but much larger amounts have been used with impunity. When administered for its action on the internal ear a sufficient amount should be taken to produce profuse sweating or salivation. The remedy should be continued a sufficient number of days to produce the desired result, unless the patient becomes greatly prostrated by its continued use or it is manifestly unavailing in the treatment of the internal ear disease. When no improvement is manifest after two weeks' use of the drug it should be abandoned. It rarely is of use except in acute cases.

Pilocarpin is a drug whose action should be carefully watched, because serious and even fatal consequences have resulted from the injection of medicinal doses. Shoemaker cites a case where the patient suddenly expired after an injection of pilocarpin. In another case the same author states that the employment of ¼ gr. was followed by profuse diaphoresis, salivation, lacrimation, a discharge from the nose, sickness of the stomach, difficulty in breathing, and a sense of cardiac oppression. Internal and external stimulation caused the symptoms to disappear. Atropin is a physiologic antidote to pilocarpin.

Pilocarpin may be given by the mouth instead of hypodermically, but its effects are longer in manifesting themselves (fifteen to twenty minutes) and more uncertain. Politzer advises the injection of 6 to 8 drops of a warm 2 per cent. solution through the Eustachian catheter into the Eustachian tube in sclerosis of the middle ear. Mendosa, in 3 cases, relieved urgent dyspnea from edema of the larynx by hypodermic injections of pilocarpin.

FORMULAS FOR USE WITH NEBULIZERS

In order to be successfully nebulized a fluid must have sufficient viscidity. *Glycerin* nebulizes fairly well, but its nebulizing qualities are greatly improved by the addition of a small proportion of tincture of benzoin. The benzoin should be added drop by drop with constant stirring of the glycerin or shaking of the bottle which contains the glycerin in order to evenly diffuse the benzoin through the glycerin, which becomes white and opaque from minute particles of benzoin suspended in the liquid. The mixture is comparatively stable and the benzoin contained in about 1 dram of the tincture can thus be suspended in 1 ounce of glycerin.

Ordinary bleached *petrolatum* oil or *albolene*, with or without the proportion of benzoin it can be made to dissolve, nebulizes fairly well.

Alcohol made viscid by the solution of one of the balsams, preferably benzoin, nebulizes fairly well. However, alcohol is somewhat irritating to the bronchial mucous membranes, and in use the product of a nebulizer containing an alcoholic solution is best diluted by the product of one containing a bland oily solution.

The alcohol evaporates somewhat rapidly during the process of nebulization, so that the fluid in the nebulizer becomes more and more concentrated until, finally, the dissolved balsams are deposited within the nebulizer tubes and clog them up to an extent to prevent the instrument working unless more alcohol is added from time to time to replenish that which has evaporated.

Any substance can be nebulized successfully if reduced to a fluid state by solution in one of the above three liquids. Essential oils and camphors are best dissolved in albolene for nebulization ; substances insoluble in oil, either in the glycerin mixture or in alcohol.

The following formulas may prove useful when used with a nebulizer. They should not be used with an atomizer, because

the amount of fluid deposited on mucous membranes by an atomizer is many times greater than that derived from a nebulizer, and some of the following solutions are sufficiently concentrated to produce deleterious results if applied to the nose or pharynx by means of an atomizer. The fact that only a minute amount of nebulized fluid is deposited on the mucous membrane of the upper respiratory tract during the short time available for the treatment of a patient during an ordinary office visit, probably accounts for the lack of enthusiasm manifested by many specialists for this method of treatment. The atomizer will probably always be the favorite instrument for applying remedies to the nose, pharynx, and larynx of office patients.

However, for the patient's use at home, especially when the circumstances are such as to allow the patient to devote considerable time to the treatment of his condition, the nebulizer possesses advantages that should not be overlooked. Also in children sufficiently nervous to be terrified by an atomizer spray, the nebulizer can be used to advantage. If necessary the nebulized fluid can be conveyed by a long rubber tube underneath a tent improvised by throwing a sheet over the shoulders of a nurse while the child is seated in her lap. By this method the air surrounding the little patient can be saturated with the nebulized vapor, thus securing a prolonged and thorough application of the remedies without producing the struggle and fright so frequent when an atomizer is employed in young children.

103. ℞ Ex. ipecacuanha, ʃ℥j ;
Glycerini, ʃ℥ij ;
Tr. benzoin comp., ʃ℥j.—M.

For use in nebulizer to relieve dryness in throat. Increases fluidity of secretions.

104. ℞ Olei cinnamomi, ♏xx ;
Olei eucalypti, ♏xx ;
Menthol, gr. xl ;
Camphor, gr. lxxx ;
Albolene, ʃ℥viij.—M.
Porch.

Antiseptic, emollient.

105. ℞ Iodin, gr. xvj ;
Camphor, ℥j ;
Menthol, ℥j ;
Oil pine-needles, ℥ij ;
Albolene, ʃ℥viij.—M.

For acute and subacute coryza, catarrh in the head passages, dry catarrh, ozena, and rhinitis. May be used regularly by public speakers, singers, actors, etc. A pleasant stimulant and protective.

106. ℞	Liq. adrenalin chlorid (1 : 5000),	ʒj ;
	Menthol,	gr. xl ;
	Olei gaultheriæ,	♏xx ;
	Glycerini,	℥ij ;
	Aquæ destil.,	ʒviij.—M.

For severe or chronic cases of hay-fever. Constringent, hemostatic, local anesthetic, antiseptic.

107. ℞	Terebeni,	℥iij ;
	Olei eucalypti,	℥j ;
	Glycerini,	ʒiv.—M.

For catarrhal conditions and as an antiseptic.

108. ℞	Chloretone,	gm. 1 ;
	Camphor,	gm. 2.5 ;
	Menthol,	gm. 2.5 ;
	Oil cinnamon,	gm. .5 ;
	Albolene,	gm. 93.5.—M. McClintock.

Anodyne, antiseptic, emollient. Useful in acute and subacute catarrh and bronchitis.

According to the manufacturers *balsamol* is a combination of balsam of Tolu, benzoin, balm of Gilead, and myrrh, with oil of Scotch pine dissolved in alcohol. *Respiral* is a combination of albolene and cocoanut oil. *Nabulin* is a glycerin compound. These compounds are used to dissolve the other ingredients in the following "Globe" formulas and render them capable of nebulization :

109. ℞	Oil eucalyptus,	℥j ;
	Oil cassia,	♏xxx ;
	Menthol,	gr. xx ;
	Balsamol,[1]	q. s. ad ℥iv.—M.

Use with nebulizer for simple catarrh of the nose, throat, and bronchial tubes, and after the first stage in all acute affections ;

[1] If the vapor from balsamol and other alcoholic solutions should seem uncomfortably pungent when applied directly to the nasal mucous membrane, it should at first be diffused or diluted either by using a mask or by holding the nasal tip near, instead of placing it in, the nostril, gradually increasing to full strength. Where a multinebulizer is used, the vapor may be diluted with that from a mild oil solution like Formula 114.

also as a preventive during epidemics of the contagious diseases, and in any case where an antiseptic and healing action is desired. Alcohol should be added occasionally as the fluid becomes too thick from evaporation.

110. ℞ Menthol, gr. xxx;
Camphor, gr. xxx;
Cocain muriate, gr. xv;
Balsamol,[1] q. s. ℥iv.—M.

Use with nebulizer for acute bronchitis, pneumonia, and all acute inflammatory affections of the air-passages. Alcohol should be added occasionally as the fluid becomes too thick from evaporation.

111. ℞ Oil cloves, ♏xxx;
Creosote (beechwood), ℥j;
Oil tar, ℥j;
Iodin, gr. xxx;
Balsamol,[1] q. s. ℥iv.—M.

Use with nebulizer for pulmonary and laryngeal tuberculosis, and in any condition requiring an active antiseptic. Alcohol should be added occasionally as the fluid becomes too thick from evaporation.

112. ℞ Chloretone, ℥iv;
Resorcin, gr. xx;
Quinin hydrobromate, ℥ij;
Balsamol,[1] q. s. ℥iv.—M.

Use in nebulizer for hay-fever, asthma, whooping-cough, etc. Alcohol should be added occasionally as the fluid becomes too thick from evaporation.

113. ℞ Chloretone, ℥ij;
Iodin, gr. xl;
Creosote, ℥ij;
Balsamol,[1] q. s. ℥iv.—M.

Use in nebulizer for tuberculosis with irritable cough, and in any condition requiring an alterative, antiseptic, and sedative action. Alcohol should be added occasionally as the fluid becomes too thick from evaporation.

114. ℞ Oil cassia, ♏xxx;
Camphor-menthol, ℥ij;
Cocain alkaloid, gr. viij;
Respirol, q. s. ℥iv.—M.

[1] See note under Formula 109.

Use with nebulizer for acute colds, sore throat, and in all cases of acute inflammation or congestion of the upper air-passages and middle ear.

115. ℞ Oil cloves, ♏xl;
Oil gaultheria, ʒj;
Cocain alkaloid, gr. xv;
Menthol, gr. xl;
Respirol, q. s. ℥iv.—M.

Use with nebulizer for acute bronchial and pulmonary congestion and inflammation, also in irritable cough of tuberculosis. It is both sedative and antiseptic.

116. ℞ Chloretone, gr. xl;
Camphor monobromate, ʒj;
Camphor-menthol, ʒj;
Oil sassafras, ʒj;
Respirol, q. s. ℥iv.—M.

Use with nebulizer for irritable and ulcerated conditions of throat.

117. ℞ Chloretone, gr. xx;
Camphor-menthol, ʒj;
Oil pinus pumilionis, ʒj;
Respirol, q. s. ℥iv.— M.

Use in nebulizer for nasopharyngeal and bronchial catarrh with a tendency to hay-fever or asthma.

118. ℞ Chloretone, gr. xl;
Camphor monobromate, ʒj;
Camphor-menthol, ʒj;
Cocain alkaloid, gr. xxx;
Oil anise, ʒj;
Oil bitter almonds, ʒj;
Respirol, q. s. ℥iv.— M.

Use in nebulizer for relief of acute paroxysms of asthma, croup, hay-fever, whooping-cough, etc.

119. ℞ Oil terebinth. (rectified), ℥iv;
Cocain alkaloid, gr. xv;
Respirol, q. s. ℥iv.—M.

Use with nebulizer for pulmonary hemorrhage.

120. ℞ Formaldehyd (40 per cent.), ℥iss;
Ext. sarsaparilla cap. fl., ℥iv;
Nebulin, ℥j;
Water, q. s. ℥iv.—M.

Use in nebulizer for diphtheria, tonsillitis, hay-fever, and all diseases of a zymotic origin, and in all conditions requiring an active germ destroyer.

121. ℞ Tannic acid, ʒj;
Nebulin, ʒj;
Cinnamon-water, q. s. ʒiv.—M.

Use with nebulizer in relaxed conditions of mucous membrane and in passive congestion. It is a simple astringent.

FORMULA FOR THE BOTTLE INHALER, CROUP KETTLE, ETC.

The steam from a kettle containing unslaked lime has been used for many years in the treatment of croup and diphtheria.

A *croup kettle* consists usually of a vessel with a long spout, to which a rubber hose is attached, by means of which steam is conveyed to the vicinity of a patient or under a croup tent erected over a bed. As the quantity of unslaked lime that will dissolve in water is not great, a piece of lime the size of a walnut is more than sufficient for several quarts of boiling water.

The following formula may be used with the bottle inhaler or added to the water in a teapot containing boiling water.

122. ℞ Tr. benzoin comp.
Sig. Add ½ teaspoonful to a bottle inhaler half-full of hot water. Use the inhaler four or five times a day.

Useful in most forms of laryngeal inflammation. To the above formula, when requisite, an expectorant—ammonia muriat., fluid extract of senega, or ipecac—may be added. When it is desired to diminish expectoration and at the same time produce a sedative effect upon the laryngeal mucous membrane, fluidextract of belladonna or hyoscyamus in combination with the compound tincture of benzoin will yield satisfactory results.

COUGH MIXTURES

Although remedies designed to affect the respiratory tract are best administered by means of an atomizer or nebulizer, and when that is impossible or inconvenient in the form of a lozenge, yet the cough mixture still retains at least a measure of its former popularity. The following formulas are effective and sometimes convenient to prescribe:

123. ℞ Syrup ipecac., fℨss;
Syrup scillæ, fℨvj;
Liq. potass. citrat., fℨj;
Mucil. acaciæ, q. s. ad. fℨiij.—M.
Sig. 1 teaspoonful in water every three hours.

Haehnlen.

Useful for controlling the coughs of children.

124. ℞ Potassii bromidi, ℨss;
Potassii cyanidi, gr. iss;
Ext. prunus virginiani, fℨss;
Ext. grindelia robustæ, fℨiij;
Muc. acaciæ,
Aquæ dest., *āā* q. s. ad. fℨiv.—M.
Sig. 1 teaspoonful in water four times a day.

Useful in the so-called "useless or dry cough" of nervous individuals due to pharyngeal irritation.

125. ℞ Morph. sulph., gr. j;
Syr. limonis, ℨij;
Syr. scillæ,
Syr. pruni virg., *āā* ℨj.—M.
Sig. 1 teaspoonful every four hours.

126. ℞ Morphinæ sulphatis, gr. ss–ij;
Potassii cyanidi, gr. iij;
Acidi sulphurici aromatici, fℨi–ij;
Syrupi pruni virginianæ, q. s. ad. fℨiij.—M.
Sig. 1 teaspoonful every two or three hours if required to prevent coughing.

Useful as an anodyne, but somewhat stimulating cough mixture.

127. ℞ Ammon. carb., ℨij;
Syr. senegæ, ℨj;
Aq. fontan., ℨiij.—M.
Sig. 1 teaspoonful every two or four hours.

Useful as an expectorant.

128. ℞ Codeinæ sulph., gr. iv;
Syr. glycyrrhizæ,
Syr. tolutani, *āā* ℨj.—M.
Sig. 1 teaspoonful every two or four hours.

129. ℞ Codeinæ, gr. iv;
Acidi hydrocyanici diluti, ♏xxxij;
Syrupi tolutani, q. s. ad. fℨij.—M.
Sig 1 teaspoonful three or four times a day.

Da Costa.

Both the above are most useful as sedative cough mixtures.

130. ℞ Heroin, gr. j;
Creosoti, ♏xvj;
Eucalyptoli, gr. viij;
Strychniæ sulphatis, gr. ¼;
Terpin hydratis, ʒss;
Syrupi aurant. cort.,
Mucilag. acaciæ, *āā* ʒj.—M.
Sig. 1 teaspoonful every three or four hours.

131. ℞ Terpin hydratis, gr. xxxvj;
Heroin hydroch., gr. j;
Ext. sumbul, gr. xij;
Ferri valerianatis, gr. xij.—M.
Fiat capsul. No. xii.
Sig. 1 every four hours.

GARGLES

Gargles are of little value unless employed with more than the usual care. Pope, by means of experiments with methylene-blue and other substances, demonstrated that as ordinarily performed gargling does not bring a medicament in contact with the fauces further back than the anterior pillars. When necessary to prescribe a gargle the patient should be instructed to close the nose tightly, throw the head far back, and gargle. By this method the probability of the fluid reaching the posterior wall of the pharynx is increased. Children cannot use a gargle, and rarely is it practical to teach a patient to gargle properly during an ordinary office visit. Gargles as ordinarily employed rarely reach the posterior wall of the pharynx and never the larynx. However, the following are cheap astringent gargles, and they may at some time be convenient to prescribe. The small amount of the gargle swallowed is, of course, effective.

132. ℞ Glycerol tannici, ʒj.
Sig. 1 teaspoonful in a half-tumbler of water. Use as a gargle.

Astringent gargle.

133. ℞ Alcoholis, 95 per cent.
Sig. Use as a gargle.

Antiseptic and astringent.

134. ℞ Listerin.
Sig. Use as a gargle.

Sedative and antiseptic.

135. ℞ Acidi tannici,
Acidi gallici, *āā* gr. xx.—M.
Sig. Add to a tumblerful of water. Gargle and swallow a portion.

As a styptic after tonsillotomy to control oozing of blood.

136. ℞ Hydrogen dioxid, 15 volumes (3 per cent.).
Sig. Use as a gargle to control oozing of blood after tonsillotomy.

137. ℞ Tincturæ ferri chloridi, ʃʒij;
Potassii bromidi, ʒij;
Potassii chloratis, ʒiij;
Ext. glycyrrhiza, ʒj;
Aquæ, q. s. ad. ʃʒvj.—M.
Sig. 1 teaspoonful in water every two hours, gargle and swallow.

Useful in acute pharyngitis and tonsillitis.

LOZENGES

Lozenges, when well made, are superior to cough syrups or gargles for the treatment of throat affections. The excipient for each formula should be selected for its harmony with the active drug and its solubility. They should be so made as to dissolve *slowly* and evenly in the mouth, thereby giving a more prolonged local effect than is possible with gargles or a spray, and a quicker and more pronounced result than can be obtained by a greater quantity of the medicant introduced into the stomach.

The favorite excipients seem to be black-currant paste and gelatin. Because of the length of time required for the drying of lozenges, druggists cannot quickly make them from the prescription of a physician, and it is therefore better in most instances to rely on the manufactured product of lozenge-makers, some of whom have national or international reputations.

A business man can carry a bottle of lozenges in his vest pocket and take one as required from time to time, when he would be embarrassed by the use of an atomizer.

However, it should be remembered that lozenges produce *both* a *local* and a *constitutional* effect and are only especially useful when this effect is desired. Where the constitutional effects of a drug is not desired its use in the form of a lozenge is less desirable than that of a spray, although the spray may be much more inconvenient for the patient.

Lozenges have in common with cough mixtures a notorious reputation for disordering the *stomach*. This is largely due to the character of the excipient and the method of manufacture. Most of the following formulas have been selected from the stock lozenges of manufacturers. Among those the writer has found most useful are—

GUAIACUM AND ITS COMBINATIONS

"In cases of deep *tonsillitis* there is, fortunately, a remedy which, if administered at the outset of the attack, will almost always cut short the crescent inflammation. This is *guaiacum.* I prescribe it as a *lozenge.* Taken in this way it seems to have a local as well as a constitutional effect."—Morell Mackenzie.

138. ℞ Troch. guaiac,. gr. ij.

The lozenges are stimulant and alterative, and are capable of arresting recent inflammation of the tonsils.

These lozenges should contain 2 gr. of the resin of guaiacum and made in accordance with Mackenzie's formula, so as to be *entirely* soluble in the mouth. They are useful in the treatment of acute and subacute inflammation of the pharynx and acute follicular disease of the tonsils.

Mackenzie claims that guaiacum is a specific in acute tonsillitis, and Sajous is equally emphatic in praise of the remedy.

139. Troch. guaiac. comp.
℞ Resin guaiac., gr. ij;
Potassii iodid, gr. j.—M.
Wm. Pepper.

Stimulant and alterative. Efficient in throat disorders with syphilitic taint. Is especially useful when in acute inflammations of the tonsils there is a sensation of dryness, as the iodid increases secretion.

140. Troch. guaiac. et acidi tannici.
℞ Resin guaiac., gr. iss;
Acidi tannici, gr. ¼.—M.
Sig. 1 lozenge to be dissolved slowly on the tongue every one or two hours.

Stimulant and astringent, probably the most useful of the guaiacum lozenges in acute and subacute inflammation of the tonsils, pharynx, and larynx. Useful in the so-called "relaxed throats" of public speakers. They are especially useful in hyperemic throat disorders caused by cold and damp atmospheric conditions. The astringent action of the tannic acid is greatly assisted by the alterative effect of the guaiacum upon the congested mucosa, and they effectively reduce the capillary tension and quickly relieve the inflammation. They are pleasant to administer and do not constipate.

141. Troch. guaiac. and benzoic acid.
℞ Resin guaiac., gr. ij;
Acidi benzoici, gr. j.—M.
J. F. Martenet.

Stimulant in nervomuscular weakness of the throat. It is somewhat useful in the treatment and the loss of control of the laryngeal muscles experienced by nervous actors, singers, and orators, and those of these professsons who have lost confidence in their powers as the result of subacute inflammation of the pharynx and larynx. In addition to the lozenge, $\frac{1}{20}$ gr. of strychnin or 1 dram of fluidextract of cocoa in 1 ounce of sherry wine may be prescribed, to be taken a few moments before going upon the stage or platform.

Any one of the above guaiacum lozenges may be used every one, two, or three hours, according to the acuteness of the inflammation.

CAMPHOMENTHOL AND ITS COMBINATIONS

142. ℞ Troch. camphomenthol, gr. $\frac{1}{10}$.
Sig. 1 lozenge dissolved on the tongue every hour or two, as required.

These lozenges exert a more soothing and corrective effect upon the nerves and blood-vessels of the mucosa than do the usual preparations of menthol. They check excessive discharges, liquefy tenacious mucus, correct perverted secretions, and are an excellent voice stimulant.

143. Troch. camphomenthol et eucalypti.
℞ Eucalyptus rostratæ (réd gum), gr. j ;
Camphomenthol, gr. $\frac{1}{10}$.—M.
Sig. 1 lozenge dissolved on the tongue every hour or two, as required.

A pleasant antiseptic astringent, with sedative effect upon irritations of the mucosa.

When greater anodyne effect is desired, in acute or chronic bronchitis, the following is an efficient and reliable sedative:

144. Troch. codein comp.
℞ Codeinæ, gr. $\frac{1}{10}$;
Camphomenthol, gr. $\frac{1}{20}$.—M.
Sig. 1 lozenge to be dissolved slowly on the tongue every one or two hours if required to prevent coughing.

145. Troch. heroin.
℞ Heroin, gr. $\frac{1}{12}$;
Camphomenthol, gr. $\frac{1}{80}$.—M.
Sig. 1 lozenge every two hours if required to relieve cough.

146. Troch. orthoform comp.
℞ Orthoform, gr. j ;
Camphomenthol, gr. $\frac{1}{10}$.—M.
Fiat troch. No. i.
Sig. 1 ten minutes before meals or as required, as a safe analgesic after throat operations and other painful conditions of the pharynx and larynx.

McConachie.

COCAIN AND ITS COMBINATIONS

Instead of the above orthoform lozenge, either of the two following may be employed in the dysphagia of tuberculous laryngitis, where greater analgesia is required:

147. Troch. cocain comp.
℞ Cocain hydroch., gr. $\frac{1}{15}$;
Extract. hyoscyami, gr. $\frac{1}{10}$;
Extract. opii, gr. $\frac{1}{20}$;
Tincturæ aconiti, ♏ $\frac{1}{2}$.—M.
Sig. 1 lozenge a few moments before eating and every two or three hours.

J. J. Chisholm.

This combination is of considerable value as an anesthetic and anodyne in the laryngeal lesions of phthisis and to control the paroxysms of asthma.

148. ℞ Cocain hydrochloridi, gm. 0.002;
Acetanilid, gm. 0.02.—M.
Fiat troch. No. i.
Sig. 1 four to six times a day.

Winslow.

These lozenges have a pungent taste and leave an agreeable tingling sensation in the throat. They are useful in chronic pharyngitis associated with painful deglutition, paresthesia, and various neurotic sensations.

149. ℞ Cocain hydrochloridi, gr. $\frac{1}{4}$–$\frac{1}{2}$.
Fiat troch. No. i.
Sig. 1 before meals to relieve painful deglutition in tuberculosis, cancer, etc., of the larynx.

AMMONIUM SALTS AND THEIR COMBINATIONS

Ammonium salts have long been used in the treatment of pharyngitis and bronchitis. They may be given in the form of a lozenge for the local effect on the pharynx, but the lozenge should be so made that the ammonium salts do not dissolve more rapidly than the other ingredients of the lozenge.

150. ℞ Troch. glycyrrhiza comp.
Sig. 1 lozenge every two or three hours.

Brown mixture lozenges should be so made that each lozenge corresponds to a teaspoonful of the well-known "brown mixture."

151. ℞ Troch. ammoniæ comp.
Sig. 1 every two or three hours.
Pennsylvania Hospital formula.

152. ℞ Ammoniæ chloridi, gr. ij.
Fiat troch. No. i.
Sig. 1 every two or three hours as a stimulating expectorant.
Morell Mackenzie.

153. Troch. ammoniæ iodidi comp.
℞ Ammoniæ iodidi, gr. j;
Ammoniæ chloridi, gr. ij;
Codeinæ, gr. $\frac{1}{8}$;
Morphinæ acetatis, gr. $\frac{1}{25}$;
Ext. prunis virginianæ, q. s.—M.
Fiat troch. No. i.
Sig. 1 every three hours as an alterative, sedative, expectorant.

MISCELLANEOUS

Some of the prescriptions under this heading are old favorites and have been popular with many physicians for years.

The three next lozenges may be given to children and adults who strenuously refuse any remedy having an unpleasant taste, as they are as pleasant as a confection.

154. Troch. mucilag. ulmi (mucilage of slippery elm).
℞ Mucilag. ulmi, q. s.
Facio troch. No. i.

These lozenges are probably the best demulcent in painful conditions of the pharynx. They are vastly different from the ordinary "slippery elm lozenges," made by grinding up the bark of the elm tree and mixing it with gum and sugar.

155. ℞ Ipecacuanhæ.
(Allen & Hanbury's, Ltd., London.)

These are large gum arabic pastils of the same strength as the lozenges of the British Pharmacopœia. They are readily taken by children and exert the expectorant effects of ipecacuanha with the demulcent characteristics of the lozenge.

156. Troch. acidi borici compositæ,
℞ Acidi benzoici, gr. ss;
Acidi borici, gr. j;
Ext. erythrox. cocæ, gr. iss.—M.
Faulkner.

This lozenge is sedative, demulcent, and of a pleasant taste. It is a valuable *voice lozenge* in cases of orators and singers of the neurotic temperament, who dread that their voice will fail them in the presence of an audience because of nervous muscular weakness. One should be slowly dissolved in the mouth every four hours. When used as a "voice lozenge" one should be taken one-quarter of an hour before using the voice and fluids should be avoided.

157. Troch. acidi carbolici.
℞ Acidi carbolici, gr. j.
Fiat troch. No. i.

Morell Mackenzie.

This formula has long been a favorite as an analgesic, antiseptic lozenge.

158. Troch. potassæ chloratis et acidi tannici.
℞ Potassæ chloratis, gr. iij;
Acidi tannici, gr. ss.—M.

Antiseptic and astringent. Is especially valuable in severe acute pharyngitis, where the mucous membrane is dusky red, much swollen, and "glazed" from scanty secretions.

159. Trochisci krameriæ (rhatany).
℞ Ext. krameriæ, gr. j.
Sig. 1 every hour.

Astringent.

160. ℞ Potassii chloratis,
Potassii bromidi,
Ext. glycyrrhizæ, *āā* gr. iij;
Tr. ferri chloridi, ℥iss.—M.
Sig. 1 every two or three hours.

Seiler.

Useful in acute pharyngitis, tonsillitis, and laryngitis.

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